JECRC™
UNIVERSITY
BUILD YOUR WORLD

Choice Based Credit Course Structure and Syllabi

B. Sc. (Physics Honors)

Department of Physics

Faculty of Sciences

Session: 2021-2024

Prof. YK Vijay

Dr Pramod Verma

(Dr. Nishant Gaur)

(Dr Abhishek Sharma

Chandan Joshi

(Dr. Chandan Joshi

CHOICE BASED CREDIT SYSTEM

Department of Physics introduces the scheme of CBCS for BSc (Honors) program in School of Sciences, JECRC University, Jaipur. The details for CBCS scheme for Science and Arts (Humanities) are described in CSR Number CUS/268 (Cir)/18 dated 07.05.2018.

The choice based credit system is comprised of several type of courses, in which some courses are compulsory termed as Core Course (CC), fundamental (Skill Enhancement Courses) and foundation courses (Ability Enhancement Courses). In addition to these, two kind of open elective courses are also there with choices: Open Electives- It can be chosen from other disciplines and Departmental Electives- It can be chosen from subject oriented courses. Each course has definite credit, summarized as below-

Course Type	Description	Credit
Core Course (CC)	Compulsory Basic Course from Physics	60
Departmental Elective (DE)	Specialized Elective Courses from Physics [Started from 3rd Semester]	41
Open Electives	Elective Courses other than Physics [In 3rd, 5th, and 6th Semester]	15
Fundamental Course	Compulsory Course not related to Physics [In first four Semesters]	16
Foundation Course	Compulsory Course [In first Four Semester]	16

Prof Y. K. Vijay

(Dr. Nishant Saini)

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Head

(Dr. Abhishek Sharma)

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(Dr. Chandan Joshi)

DEPARTMENT OF PHYSICS
FACULTY OF SCIENCE
BSC (HONROS) PHYSICS - STUDY SCHEME

S.No.	Semester	Subject code	Subject	Lecture Hours	Tutorial Hours	Practical Hours	Total Hours	Lecture Credit	Tutorial Credit	Practical Credit	Total Credits	Course Type
1	1	BPH063A	Mechanics	4	0	0	4	4	0	0	4	Core
2	1	BPH011B	Mechanics (Lab)	0	0	2	2	0	0	1	1	Core
3	1	BPH006B	Optics	4	0	0	4	4	0	0	4	Core
4	1	BPH008C	Optics (Lab)	0	0	2	2	0	0	1	1	Core
5	1	BPH010B	Electricity & Magnetism	4	0	0	4	4	0	0	4	Core
6	1	BPH012B	Electricity & Magnetism (Lab)	0	0	2	2	0	0	1	1	Core
7	1	DCA001A	Web Development	2	0	0	2	2	0	0	2	Fundamental
8	1	DCA002A	Web Development Lab	0	0	2	2	0	0	1	1	Fundamental
9	1	DEN001A	Communication Skills	2	0	2	4	2	0	1	3	Foundation
10	1	DIN001A	Culture Education -1	2	0	0	2	2	0	0	2	Foundation
11	1	DCH101A	Environment Studies	3	0	2	5	3	0	1	4	Fundamental
			Total	**21**	**0**	**12**	**33**	**21**	**0**	**6**	**27**	

S.No.	Semester	Subject code	Subject	Lecture Hours	Tutorial Hours	Practical Hours	Total Hours	Lecture Credit	Tutorial Credit	Practical Credit	Total Credits	Course Type
1	2	BPH064A	Thermodynamics & Statistical Physics	4	0	0	4	4	0	0	4	Core
2	2	BPH065A	Thermodynamics & Statistical Physics (Lab)	0	0	2	2	0	0	1	1	Core
3	2	BPH066A	Mathematical Physics & Relativity	4	0	0	4	4	0	0	4	Core
4	2		Mathematical Physics & Relativity (Tutorial)	0	1	0	1	0	1	0	1	Core
5	2	BPH067A	Elements of Modern Physics	4	0	0	4	4	0	0	4	Core
6	2	BPH068A	Elements of Modern Physics (Lab)	0	0	2	2	0	0	1	1	Core
7	2	BPH069A	Waves & Vibrations	4	0	0	4	4	0	0	4	Core
8	2	BPH070A	Waves & Vibrations (Lab)	0	0	2	2	0	0	1	1	Core
9	2	DCA003A	Project Management Lab	0	0	2	2	0	0	1	1	Fundmental
10	2	DEN002A	Professional Skills	2	0	2	4	2	0	1	3	Foundation
11	2	DIN002A	Culture Education -2	2	0	0	2	2	0	0	2	Foundation
			Total	**20**	**1**	**10**	**31**	**20**	**1**	**5**	**26**	

(Dr. Nishant Grover)

(Dr. Abhishek Shrivastava)
Chandan Joshi
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DEPARTMENT OF PHYSICS

FACULTY OF SCIENCE

BSC (HONROS) PHYSICS - STUDY SCHEME

S.No.	Semester	Subject code	Subject	Lecture Hours	Tutorial Hours	Practical Hours	Total Hours	Lecture Credit	Tutorial Credit	Practical Credit	Total Credits	Course Type
1	3	BPH071A	Advanced Mathematical Physics	4	0	0	4	4	0	0	4	Core
2	3	BPH072A	Advanced Mathematical Physics (Lab)	0	0	2	2	0	0	1	1	Core
3	3	BPH073A	Circuit Analysis and Basic Electronics	4	0	0	4	4	0	0	4	Core
4	3	BPH074A	Circuit Analysis and Basic Electronics (Lab)	0	0	2	2	0	0	1	1	Core
5	3	BPH081A/83A/85A	DE1	4	0	0	4	4	0	0	4	DE
6	3	BPH082A/84A/86A	DE1 (Lab)	0	0	2	2	0	0	1	1	DE
7	3	DCA004A	Advanced Spread Sheet Lab	0	0	2	2	0	0	1	1	Fundamental
8	3	DEN003A	Life Skills-1(Aptitude)	1	0	2	3	1	0	1	2	Foundation
9	3	DIN003A	Value Education and Ethics-1	1	0	0	1	1	0	0	1	Foundation
10	3		Open Elective-I	3	0	0	3	3	0	0	3	Interdisciplinary
11	3		Open Elective-II	3	0	0	3	3	0	0	3	Interdisciplinary
			Total	**20**	**0**	**10**	**30**	**20**	**0**	**5**	**25**	

S.No.	Semester	Subject code	Subject	Lecture Hours	Tutorial Hours	Practical Hours	Total Hours	Lecture Credit	Tutorial Credit	Practical Credit	Total Credits	Course Type
1	4	BPH017B	Solid State Physics	4	0	0	4	4	0	0	4	Core
2	4	BPH075A	Solid State Physics (Lab)	0	0	2	2	0	0	1	1	Core
3	4	BPH021B	Nuclear and Particle Physics	4	0	0	4	4	0	0	4	Core
4	4		Nuclear and Particle Physics (Tutorial)	0	1	0	1	0	1	0	1	Core
5	4	BPH087A/89A/91A	DE2	4	0	0	4	4	0	0	4	DE
6	4	BPH088A/90A/92A	DE2 (Lab/Seminar)	0	0	2	2	0	0	1	1	DE
7	4	DCA005A	Python Programming	2	0	0	2	2	0	0	2	Fundamental
8	4	DCA006A	Python Programming Lab	0	0	2	2	0	0	1	1	Fundamental
9	4	DEN004A	Life Skills-2 (Personality Development)	1	0	2	3	1	0	1	2	Foundation
10	4	DIN004A	Value Education and Ethics-2	1	0	0	1	1	0	0	1	Foundation
11	4	REM001	Research Methodology	3	1	0	4	3	1	0	4	Fundamental
			Total	**19**	**2**	**8**	**29**	**19**	**2**	**4**	**25**	

(Dr. Nishant Rawat)

Dr. Pawan Lagwal
Head

(Dr. Abhishek Sharma)

(Dr. Chandan Joshi)

DEPARTMENT OF PHYSICS
FACULTY OF SCIENCE
BSC (HONROS) PHYSICS - STUDY SCHEME

S.No.	Semester	Subject code	Subject	Lecture Hours	Tutorial Hours	Practical Hours	Total Hours	Lecture Credit	Tutorial Credit	Practical Credit	Total Credits	Course Type
1	5	BPH014B	Quantum Mechanics	4	0	0	4	4	0	0	4	Core
2	5	BPH076A	Quantum Mechanics (Lab)	0	0	2	2	0	0	1	1	Core
3	5	BPH093A/95A/97A	DE3	4	0	0	4	4	0	0	4	DE
4	5	BPH094A/96A/98A	DE3 (Lab/Seminar)	0	0	2	2	0	0	1	1	DE
5	5	BPH099A/101A/103A/105A	DE4	4	0	0	4	4	0	0	4	DE
6	5	BPH100A/102A/104A/106A	DE4 (Lab/Seminar)	0	0	2	2	0	0	1	1	DE
7	5		Open Elective III	3	0	0	3	3	0	0	3	Interdiscpilinary
8	5	BPH026A	Project	0	0	12	12	0	0	6	6	DE
				15	0	18	33	15	0	9	24	

S.No.	Semester	Subject code	Subject	Lecture Hours	Tutorial Hours	Practical Hours	Total Hours	Lecture Credit	Tutorial Credit	Practical Credit	Total Credits	Course Type
1	6	BPH0107A/109A/111A/113A	DE5	4	0	0	4	4	0	0	4	DE
2	6	BPH0108A/110A/112A	DE5 (Lab/Seminar)	0	0	2	2	0	0	1	1	DE
3	6	BPH0114A/116A/118A/120A	DE6	4	0	0	4	4	0	0	4	DE
4	6	BPH0115A/117A/119A/121A	DE6 (Lab/Seminar)	0	0	2	2	0	0	1	1	DE
5	6	BPH0122A/124A/126A/128A	DE7	4	0	0	4	4	0	0	4	DE
6	6	BPH0123A/125A/127A/129A	DE7 (Lab/Seminar)	0	0	2	2	0	0	1	1	DE
7	6		Open Elective-IV	3	0	0	3	3	0	0	3	Interdisciplinary
8	6		Open Elective-V	3	0	0	3	3	0	0	3	Interdisciplinary
				18	0	6	24	18	0	3	21	

Semester VI: **Note: In 6th Semester Student have a Choice either he can go for offered Courses or he may avail Internship in some reputed Institute / Industry or In House

Total Credit

Semester	1	2	3	4	5	6	Total
Credit	27	26	25	25	24	21	148

(Dr. Nishant Kaur)

(Dr. Abhishek Sharma)

CODES OF CORE COURSES

S. No.	Codes	Course Name	Semester
1	BPH063A	Mechanics	I
2	BPH011B	Mechanics Lab	I
3	BPH006B	Optics	I
4	BPH008C	Optics Lab	I
5	BPH010B	Electricity & Magnetism	I
6	BPH012B	Electricity & Magnetism Lab	I
7	BPH064A	Thermodynamics and Statistical Physics	II
8	BPH065A	Thermodynamics and Statistical Physics Lab	II
9	BPH066A	Mathematical Physics and Relativity	II
10	BPH067A	Elements of Modern Physics	II
11	BPH068A	Elements of Modern Physics Lab	II
12	BPH069A	Waves & Vibrations	II
13	BPH070A	Waves & Vibrations Lab	II
14	BPH071A	Advanced mathematical Physics	III
15	BPH072A	Advanced mathematical Physics Lab	III
16	BPH073A	Circuit Analysis and Basic Electronics	III
17	BPH074A	Circuit Analysis and Basic Electronics Lab	III
18	BPH017B	Solid State of Physics	IV
19	BPH075A	Solid State of Physics Lab	IV
20	BPH021B	Nuclear and Particle Physics	IV
21	BPH014B	Quantum Mechanics	V
22	BPH076A	Quantum Mechanics Lab	V

OPEN ELECTIVES COURSES

[For BTech / BSc (Honors) other than Physics Honors]

S. No.	Code	Course Name	Semester
1.	DPH005A	Mechanics	III, V
2.	DPH006A	Optics	III, V
3.	DPH007A	Electricity and Magnetism	III, V
4.	DPH008A	Circuit Analysis & Basic Electronics	III, V
5.	DPH009A	Elements of Modern Physics	VI
6.	DPH010A	Solid State Physics	VI
7.	DPH011A	Nuclear and Particle Physics	VI

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(Dr. Nishant Chauhan)
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(Dr Abhishek Sh

CODES OF DEPARTMENTAL ELECTIVE (DE) COURSES

[Physics Oriented Elective Papers]

S. No.	Codes	Course Name	Semester
1	BPH081A	Digital Electronics and Devices	III
2	BPH082A	Digital Electronics and Devices Lab	III
3	BPH083A	Structure and Properties of Materials	III
4	BPH084A	Structure and Properties of Materials Lab	III
5	BPH085A	Introduction to Astronomy and Astrophysics	III
6	BPH086A	Introduction to Astronomy and Astrophysics Lab	III
7	BPH087A	Analog Circuits	IV
8	BPH088A	Analog Circuits Lab	IV
9	BPH089A	Mechanics of Materials	IV
10	BPH090A	Mechanics of Materials Lab	IV
11	BPH091A	Stellar Structure and Evolution	IV
12	BPH092A	Stellar Structure and Evolution Seminar	IV
13	BPH093A	Advanced Materials	V
14	BPH094A	Advanced Materials Seminar	V
15	BPH095A	Opto Electronics	V
16	BPH096A	Opto Electronics Lab	V
17	BPH097A	Physics of the Sun	V
18	BPH098A	Physics of the Sun Lab	V
19	BPH099A	Electromagnetic Theory	V
20	BPH100A	Electromagnetic Lab	
21	BPH101A	Communication Systems	V
22	BPH102A	Communication Systems Lab	V
23	BPH103A	Composite Materials	V
24	BPH104A	Composite Materials Lab	V
25	BPH105A	Galaxies and Universe	V
26	BPH106A	Galaxies and Universe Lab	V
27	BPH107A	Fundamental of Plasma Physics	VI
28	BPH018A	Fundamental of Plasma Physics Seminar	VI
29	BPH109A	Electronic Instrumentation	VI
30	BPH110A	Electronic Instrumentation Lab	VI
31	BPH111A	Computational Material Science	VI

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32	BPH112A	Computational Material Science Lab	VI
33	BPH113A	Radiation Processes in Astrophysics	VI
34	BPH114A	Elements of Atomic and Molecular Physics	VI
35	BPH115A	Elements of Atomic and Molecular Physics Seminar	VI
36	BPH116A	Microprocessors and Microcontroller	VI
37	BPH117A	Microprocessors and Microcontroller Lab	VI
38	BPH118A	Material Characterization Techniques	VI
39	BPH119A	Material Characterization Techniques Seminar	VI
40	BPH120A	Planetary and Atmospheric Science	VI
41	BPH121A	Planetary and Atmospheric Science Seminar	VI
42	BPH122A	Renewable Energy	VI
43	BPH123A	Renewable Energy Seminar	VI
44	BPH124A	Antenna Theory and Propagation	VI
45	BPH125A	Antenna Theory and Propagation Lab	VI
46	BPH126A	Fundamental of Polymer Science	VI
47	BPH127A	Fundamental of Polymer Science Seminar	VI
48	BPH128A	Astronomical Techniques	VI
49	BPH129A	Astronomical Techniques Seminar	VI

Prof. Y.K. Vijay

(Dr. Nishant Kumar)

(Dr. Abhishek Sharma)

Dr Pramod Sharma

(Dr. Chandan Joshi)

PROGRAM OBJECTIVES (POs)

I. **Disciplinary Knowledge:** Capable of demonstrating good procedural knowledge and systematic understanding of major concepts, theoretical principles and experimental findings in Physics and its different learning subfields and applications.

II. **Technical Skill:** Acquire the ability to use modern instrumentation and laboratory techniques to design and perform experiments are highly desirable in almost all the fields of physics. Realize the importance of mathematical modeling to understand problems in physical world.

III. **Critical Thinker and Problem Solver:** Develop a strong analytical skill and will be able to study critically a physics problem, solve the problem using different tools and present the result/conclusion. Develop global competencies in handling the open ended problems belongs to disciplinary fields of physics.

IV. **Sense of Inquiry:** Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Physics, executing physics experiments, analyze and interpret data/information collected using appropriate methods and report the findings of the experiment to the relevant theories of Physics.

V. **Digitally Efficient:** Capable of using computers for simulation and computation for better understanding of problems in Physics. Students will be aware of appropriate software for numerical and statistical analysis of data available now days and will be able to retrieve Physics information from e-libraries and other e-sources available using internet.

VI. **Skilled Project Manager:** Capable of identifying appropriate resources required for a project, and manage a project through to completion, while observing responsible and ethical scientific conduct with safety measurements.

VII. **Ethical Awareness:** Capable of demonstrating ability to think and analyze rationally and to identify the potential ethical and moral issues in work-related situations, to enhance intellectual property, environmental and sustainability issues, and promoting safe learning and working environment as professional behavior.

VIII. **National and International Perspectives:** Capable of preparing themselves for their appropriate role in contributing towards the national development and projecting our national priorities at the international level pertaining to their field of interest.

IX. **Lifelong Learners:** Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and re-skilling in all areas of Physics.

Dr Pranav Sinha

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BSc (Honors) Physics

CLASSIFICATION OF SPECIALIZATIONS WITH DEPARTMENTAL ELECTIVES (DE)

	Sem-III: Departmental Elective 1			Sem-IV: Departmental Elective 2			Sem-V: Departmental Elective 3			Sem-V: Departmental Elective 4			Sem-VI: Departmental Elective 5			Sem-VI: Departmental Elective 6			Sem-VI: Departmental Elective 7		
	Course Code	Course Name	Course Credit (L,T,P)	Course Code	Course Name	Course Credit (L,T,P)	Course Code	Course Name	Course Credit (L,T,P)	Course Code	Course Name	Course Credit (L,T,P)	Course Code	Course Name	Course Credit (L,T,P)	Course Code	Course Name	Course Credit (L,T,P)	Course Code	Course Name	Course Credit (L,T,P)
General Honors	BPH081A	Digital Electronics	4	BPH087A	Analog Circuits	4	BPH093A	Advanced Materials	4	BPH099A	Electromagnetic Theory	4	BPH107A	Fundamental of Plasma Physics	4	BPH114A	Elements of Atomic and Molecular Spectroscopy	4	BPH122A	Renewable Energy	4
	BPH082A	Digital Electronics (Lab)	1	BPH088A	Analog Circuits (Lab)	1	BPH094A	Advanced Materials-Seminar	1	BPH100A	Electromagnetic (Lab)	1	BPH108A	Fundamental of Plasma Physics - Seminar	1	BPH115A	Elements of Atomic and Molecular Spectroscopy - Seminar	1	BPH123A	Renewable Energy - Seminar	1
Electronics and Communication Science	BPH081A	Digital Electronics	4	BPH087A	Analog Circuits	4	BPH095A	Opto Electronics	4	BPH101A	Communication Systems	4	BPH109A	Electronic Instrumentation	4	BPH116A	Microprocessors and Microcontrollers	4	BPH124A	Antenna Theory and Propagation	4
	BPH082A	Digital Electronics (Lab)	1	BPH088A	Analog Circuits (Lab)	1	BPH096A	Opto Electronics (Lab)	1	BPH102A	Communication Systems (Lab)	1	BPH110A	Electronic Instrumentation (Lab)	1	BPH117A	Microprocessors and Microcontroller (Lab)	1	BPH125A	Antenna Theory and Propagation (Lab)	1
Material Science	BPH083A	Structure and Properties of Materials	4	BPH089A	Mechanics of Materials	4	BPH093A	Advanced Materials	4	BPH103A	Composite Materials	4	BPH111A	Computational Material Science	4	BPH118A	Material Characterization Techniques	4	BPH126A	Fundamental of Polymer Science	4
	BPH084A	Structure and Properties of Materials (Lab)	1	BPH090A	Mechanics of Materials (Lab)	1	BPH094A	Advanced Materials - Seminar	1	BPH104A	Composite Materials (Lab)	1	BPH112A	Computational Material Science (Lab)	1	BPH119A	Material Characterization (Lab)	1	BPH127A	Fundamental of Polymer Science - Seminar	1
Astrophysics and Astronomy	BPH085A	Introduction to Astronomy and Astrophysics	4	BPH091A	Stellar Structure and Evolutions	4	BPH097A	Physics of Sun	4	BPH105A	Galaxies and Universe	4	BPH113A	Radiation Processes in Astrophysics	4	BPH120A	Planetary and Atmosppheric Science	4	BPH128A	Astronomical Techniques	4
	BPH086A	Hands on Practice Lab-I	1	BPH092A	Hands on Practice Lab-II	1	BPH098A	Physics of Sun - Seminar	1	BPH106A	Galaxies and Universe-Seminar	1	-	Tutorial	1	BPH121A	Planetary and Atmosppheric Science-Seminar	1	BPH129A	Astronomical Techniques-Seminar	1

Dr Pranav Sakore

Prof. V.K. Vijay

(Dr. Nishant Gaur)

(Dr. Chandan Joshi)

(Dr Abhishek Shorny)

SEMESTER - I

(CORE COURSES)

MECHANICS

CODE: BPH063A **CREDIT(S): 4**

UNIT-I

Kinematics – Position, velocity and acceleration (ID and 3D)

Work and Energy Theorem: Work and Kinetic Energy Theorem. Conservative and Non-Conservative Forces. Potential Energy. Energy Diagram. Stable and Unstable Equilibrium. Gravitational Potential Energy. Elastic Potential Energy. Force as Gradient of Potential Energy. Work and Potential energy. Work done by Non-conservative Forces. Law of Conservation of Energy.

Collisions: Elastic and Inelastic Collisions between particles. Centre of Mass and Laboratory Frames.

UNIT-II

Rotational Dynamics: Angular Momentum of a Particle and System of Particles. Torque. Conservation of Angular Momentum. Rotation about a Fixed Axis. Moment of Inertia. Calculation of Moment of Inertia for Rectangular, Cylindrical, and Spherical Bodies. Kinetic Energy of Rotation. Motion involving both Translation and Rotation.

UNIT-III

Elasticity: Relation Between Elastic Coefficients. Twisting Torque on a Cylinder or Wire.

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

UNIT-IV

Gravitation and Central Force Motion: Law of gravitation. Inertial and Gravitational Mass. Momentum of variable-mass system: Motion of rocket. Motion of a projectile in Uniform gravitational field, Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse

Potential and Field due to Spherical Shell and Solid Sphere. Motion of a Particle under Central Force Field. Two Body Problem and its Reduction to One Body Problem and its Solution. The Energy Equation and Energy Diagram. Kepler's Laws (Ideas Only). Orbits of Artificial Satellites.

UNIT-V

Inertial and Non- Inertial Systems: Reference Frames: Inertial Frames and Galilean Transformations. Galilean Invariance and Conservation Laws. Non-inertial Frames and Fictitious Forces. Uniformly Rotating Frame. Physics Laws in Rotating Coordinate Systems. Centrifugal forces: Coriolis Force and its Applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Suggested Books

1. University Physics; F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
2. An introduction to Mechanics; Daniel Kleppner, Robert J. Kolenkow, McGraw-Hill, 1973.
3. Theoretical Mechanics; M.R. Spiegel, 2006, Tata McGraw Hill
4. Mechanics Charles Kittel, Walter Knight, Malvin Ruderman, Carl Helmholz, Burton Moyer, Berkeley physics course.
5. Mechanics; D. S. Mathur, S. Chand & Company Limited, 2000.

Course Outcomes: After completing this course, students shall be able to-

CO1: Understand laws of motion and their application, various laws of conservation, collisions and idea about center of mass and laboratory frames.

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CO2: Understand of moment of inertia about the given axis for different uniform mass distributions, the basics of kinematics and dynamics linear and rotational motion.
CO3: Learn the concepts of elastic in constant of solids and viscosity of fluids.
CO4: Learn skills to understand and solve the equations of Newtonian gravity and central force problem and applications of Kepler's law.
CO5: distinguish the inertial and non-inertial systems and understand the experiences of fictitious forces in a non-inertial frame.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	H					M
CO2	L	M		H				M	
CO3	M		H				M		L
CO4	L	H	H	M				L	M
CO5	M		M	L				L	

H=High; M=Medium; L=Low

MECHANICS LAB

CODE: BPH011B **CREDIT: 1**

Student has to perform / learn any ten experiments out of the following experiments:-

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the height of a building using a Sextant.
3. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
4. To determine the elastic constants of a wire by Searle's method.
5. To find the Torque and angular acceleration of a fly wheel
6. To determine the moment of inertia of fly wheel.
7. To study the torsional oscillation of pendulum in different liquids and determine the rigidity modulus of the suspension wire using torsion pendulum.
8. To verify that energy conservation and momentum conservation can be used with a ballistic pendulum to determine the initial velocity of a projectile, its momentum and kinetic energy
9. To find the Time of flight, Horizontal range and maximum height of a projectile for different velocity, angle of projection, cannon height and environment.
10. To verify the momentum and kinetic energy conservation using collision balls.
11. Study of variation of Momentum, Kinetic energy, Velocity of collision of the objects and the Center of Mass with different velocity and mass and calculation of the Momentum, Kinetic energy, and Velocity after collision.
12. To determine g, the acceleration of gravity at a particular location using Kater's Pendulum

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Dr. Kumar Sanjay Nand (Dr. Nishant Kumar)
Chandan Gothi (Dr. Chandan Jothi)

13. To determine the time period of oscillations and acceleration of gravity g using compound pendulum.
14. To find the viscosity of different liquid by rotating cylinder method.
15. *To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
16. *To determine the Young's Modulus of a Wire by Optical Lever Method.

Suggested Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced Level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

Course Outcomes: After completion this course, student shall be able to

CO1: Learn the mechanics of basic instruments and elastic properties (Young Modulus and Modulus of Rigidity)
CO2: Learn the linear dynamics by performing compound pendulum, rotational dynamics using Flywheel and torsional oscillations.
CO3: Understand fluid dynamics (verification of Stokes law, Searle method) and mechanics of collisions and projectile motion.
CO4: To understand the effect of gravity by calculating g using Kater's and compound pendulum.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M	M	L	M					
CO2		H	H	L	M	L			
CO3	H		M	M	L	M			
CO4		M		H	M	M			

H=High; M=Medium; L=Low

Dr. Pranay Saxena

Prof. Y.K. Vijay

(Dr. Nishant Rawat)

Chandan Joshi (Dr. Abhishek Sharma)

(Dr. Chandan Joshi)

OPTICS

CODE: BPH006B **CREDIT(S): 4**

UNIT-I

Geometrical Optics : Fermat's Principle: Fermat's Principle of Least Time and Extremum Path. Laws of Reflection and Refraction, Laws of Refraction at Spherical Surface, Thin lens Formula.

Wave Optics: Nature of Light- Theories of Light. Electromagnetic Nature of Light, Definition of a Wave Front. Propagation of a Wave Front. Huygens Principle of Secondary Wavelets.

UNIT-II

Interference: Interference: Division of Amplitude and Division of Wavefront. Young's Double Slit Experiment. Lloyd's Mirror and Fresnel's Biprism. Phase Change on Reflection: Stoke's treatment. Interference in Thin Films: Parallel and Wedge-shaped Films. Fringes of Equal Inclination (Haidinger Fringes) and Fringes of Equal Thickness (Fizeau Fringes). Newton's Rings: Measurement of Wavelength and Refractive Index. Michelson's Interferometer: (1) Idea of form of fringes (No Theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, (5) Standardization of Meter. Fresnel's Biprism: Non localized fringes, Visibility of fringes.

UNIT-III

Fresnel's Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula (Qualitative Discussion), Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Comparison of a Zone plate with a Convex lens. Diffraction due to a Straight Edge, Rectangular Aperture (Slit), Small Circular Aperture, an Opaque Circular Disc. Fresnel's Integrals, Cornu's Spiral: Fresnel Diffraction Pattern due to a Straight Edge.

Fraunhoffer Diffraction: Diffraction due to a Single Slit, a Double Slit and a Plane Transmission Grating. Rayleigh's criterion of resolution. Resolving Power and Dispersive Power of a Plane Diffraction Grating.

UNIT-IV

Polarization: Electromagnetic nature of light, Polarized light, Plane of vibrations and plane of polarizations, linearly polarized light by (i) reflection (Brewster's law), (ii) refraction, (iii) scattering, (iv) selective absorption, (v) double refraction; Polarizer and Analyzer - Malus law, Huygen's wave theory for double refraction – E Ray and O Ray, positive and negative crystals; production of circularly and elliptically polarized light, Quarter and Half Wave Plates – Analysis of polarized light, Laws of optical activity, Specific Rotation, Lorentz Half shade polarimeter, Biquartz polarimeter.

UNIT-V

Coherence: Wave Train, Temporal Coherence - Coherence length and Coherence time Spectral Purity. Spatial Coherence and Size of the Source. Visibility as a Measure of Coherence, Applications of coherence.

Suggested Books

1. Fundamentals of Optics; F. A. Jenkins and Harvey Elliott White, McGraw-Hill, 1976.
2. Priciples of Optics; B. K. Mathur, 1995, Gopal Printing
3. A Text Book of Optics; N Subrahmanyam, Brij Lal and Avadhanulu, S. Chand.
4. Fundamentals of Optics; H.R. Gulati and D.R. Khanna, R. Chand Publications, 1991.
5. Optics; Eugene Hecht and A R Ganesan, Pearson Education, 2002.
6. Contemporary Optics; A. K. Ghatak & K. Thyagarajan, Plenum Press, 1978.

Prof. Y.K. Vijay

(Dr. Nishant Sarv)

Dr. Pramod Sharma

Chandan Joshi

(Dr. Chandan Joshi)

Course Outcomes: After the completion of course, student shall be able to

CO1: Understand geometrical approximation, Fermat's and Huygen's principles, and the paraxial matrix formalism for refractive and reflective surfaces, including Guass thin lens formula.
CO2: Learn the basic understanding of Interference with different interferometric devices and analytical understanding of fringes formation in various applications.
CO3: Understand and Analyze the bending of light phenomena due to various zones and optical devices formation of Cornu's spiral and resolving power of instruments.
CO4: Learn the production of polarized light, role of optical crystals and retardation plates, analysis of specific rotation of light.
CO5: Learn the importance of coherence in order to produce the quality light source.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		M						
CO2	H	M	H	M				L	M
CO3		H	M	L				L	
CO4	M	L	H	M					M
CO5	H			L				M	M

H=High; M=Medium; L=Low

OPTICS LAB

CODE: BPH008C **Credit(s): 1**

Student has to perform / learn any ten experiments out of following experiments:-

1. To determine resolving power of telescope.
2. To determine the wavelength of prominent lines of Mercury by using plane Diffraction Grating.
3. To determine dispersive power of a prism using mercury light source and spectrometer.
4. To determine the specific rotation of glucose/sugar solution by polarimeter.
5. To determine the wavelength of Sodium light using diffraction grating and spectrometer.
6. To determine wavelength of sodium light using Fresnel Biprism.
7. To determine wavelength of sodium light by Newton's rings' experiment.
8. To determine the dispersive power of a plane diffraction rrating.
9. To determine transmission coefficient of a semi-transparent glass plate using LB Photometer.
10. To find the Cauchy's constants of a given prism for different pairs of spectral colors using spectrometer.
11. To study of variation of angle of deviation (d) with angle of incidence (i) using a prism and spectrometer and to draw the i-d curve
12. To determine the refractive index of thin glass plate by Michelson's Interferometer.
13. To determine the focal length of the combination of the two lenses separated by a distance
14. To study the polarization of light using He-Ne laser

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(Dr. Nishant Gupta)

Chandan Joshi

(Dr. Chandan Joshi)

(Dr. Abhishek Sharma)

15. *To verify the Malus' Law.
16. *To study the Diffraction pattern due to single slit using laser light.

Suggested Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

Course Outcomes: After completion this course, student shall be able to

CO1: Acquire thorough fundamental knowledge within interferometry, coherence, polarization and diffraction.
CO2: To understand various optical phenomena, principles, workings and applications optical instruments like biprism, interferometer, diffraction grating and prism
CO3: Student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light.
CO4: The student will get a thorough knowledge of the polarization of light and its changes upon reflection and transmission.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M	H			L				
CO2	H	M	M			H			M
CO3	M	H	M	M	M				
CO4		H							M

H: High; M: Medium; L: Low

ELECTRICITY AND MAGNETISM

CODE: BPH010B **CREDIT: 4**

UNIT-I

Electric Field: Electric Field: Electric Field and Lines. Electric Field **E** due to a Ring of Charge. Electric Flux. Gauss's law. Gauss's law in Differential form. Applications of Gauss's Law: **E** due to point charge, an Infinite Line of Charge, Uniformly charged spherically shell and solid sphere, a Charged Cylindrical Conductor, an Infinite Sheet of Charge and Two Parallel Charged Sheets, Two Charged Concentric Spherical Shells. Force on the Surface of a Charged Conductor and Electrostatic Energy in the medium surrounding a Charged Conductor.

UNIT-II

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(Dr. Nishant Kaur)
Dr. Ramavtar Sharma
(Dr. Chandan Joshi)
Dr. Abhishek Sharma

Electric Potential: Line Integral of Electric Field. Conservative Nature of Electrostatic Field. Relation between **E** and V. Electrostatic Potential Energy of a System of Charges. Electric Potential due to Dipole, a Charged Wire, a Charged Disc. Calculation of Electric Field from Potential, Force and Torque on a Dipole. Conductors in an Electrostatic Field. Capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser.

UNIT-III

Dielectric Properties of Matter: Dielectrics: Electric Field in Matter. Dielectric Constant. Parallel Plate. Capacitor with a Dielectric. Polarization, Polarization Charges and Polarization Vector. Electric Susceptibility. Gauss's law in Dielectrics. Displacement vector **D**. Relations between the three Electric Vectors. Capacitors filled with Dielectrics.

UNIT-IV

Magnetic Field: Magnetic Effect of Currents: Magnetic Field **B**. Magnetic Force between Current Elements and Definition of **B.** Magnetic Flux. Biot-Savart's Law: **B** due to (1) a Straight Current Carrying Conductor and (2) Current Loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital law (Integral and Differential Forms): B due to (1) a Solenoid and (2) a Toroid. Properties of **B.** Forces on an Isolated Moving Charge. Magnetic Force on a Current Carrying Wire. Torque on a Current Loop in a Uniform Magnetic Field.

UNIT-V

Magnetic Properties of Matter: Magnetization vector **(M).** Magnetic Intensity **(H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis.

Electromagnetic induction: Faraday's law (Differential and Integral forms). Lenz's Law. Self and Mutual Induction. Energy stored in a Magnetic Field.

Maxwell's Equations: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves.

Reference Books

1. Edward M. Purcell: Electricity and Magnetism, McGraw-Hill Education, 1986.
2. Arthur F. Kip: Fundamentals of Electricity and Magnetism, McGraw-Hill, 1968.
3. D C Tayal; Electricity and Magnetism, Himalaya Publishing House, 1988
4. J. H. Fewkes & John Yarwood: Electricity & Magnetism, Oxford Univ. Press, 1991.
5. David J. Griffiths: Introduction to Electrodynamics, Benjamin Cummings, 1998 (Also, PHI).

Course Outcomes: After completion this course, student shall be able to-

CO1: Demonstrate the fundamentals of electrostatics and formalism of electric field due to various geometrical charge conductors.

CO2: Articulate the knowledge of dipole, conductors and capacitors / condenser in terms of electric potential.

CO3: Describe the properties and behavior of dielectric materials with understanding of Gauss' law.

CO4: Describe the production of magnetic field due to current carrying elements and magnetic dipole.

CO5: Explain Faraday-Lenz to articulate the relationship between electric and magnetic fields and behavior of Maxwell laws in different mediums.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Prof. V.K. Vijay

(Dr. Nishant Rawat)
Dr Kamal Sharma

Chandan Joshi
(Dr. Chandan Joshi)

(Dr Abhishek Sharma)

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		H	M			L			
CO2	H			L				L	H
CO3	M	H	M		L	M			
CO4	H	H	M	M	L		L		M
CO5			H			l			H

H = Highly Related; M = Medium L = Low

ELECTRICITY AND MAGNETISM LAB

CODE: BPH012B **CREDIT:1**

Student has to perform / learn any ten experiments out of the followings:-

1. To use a Multimeter for measuring (a) Resistances, (b) A/C and DC Voltages, (c) AC and DC Currents, (d) Capacitances, and (e) Frequencies.
2. To convert a Galvanometer into an Ammeter of given range and calibrate it.
3. To convert a Galvanometer into a Voltmeter of given range and calibrate it.
4. To determine specific resistance of a wire by Carrey-Foster's Bridge.
5. To study LCR circuit characteristics.
6. To study L-C transmission line and determine attenuation coefficient.
7. To study R-C transmission line and determine attenuation coefficient.
8. To determine an unknown resistance using *de-Sauty Bridge*.
9. To determine an unknown resistance using *Anderson Bridge*.
10. To determine characteristics of Solar Cell. (Complete Kit)
11. To study charging and discharging of a capacitor and determine time constant.
12. To study the Van De Graff generator to produce accelerated high energy particles.
13. To study the variation of magnetic field with distance along the axis of a circular coil carrying current.
14. To find the horizontal intensity of earth's magnetic field at a place and moment of the bar magnet.
15. To determine the magnetic dipole moment (m) of a bar magnet and horizontal intensity (B_H) of earth's magnetic field using a deflection magnetometer.
16. To find the temperature coefficient of resistance of a given coil using Wheatstone bridge circuit
17. To determine the self inductance of the coil (L) using Anderson's bridge.
18. To calculate the value of inductive reactance (X_L) of the coil at a particular frequency using Anderson's bridge.
19. To determine the volume magnetic susceptibility of Manganese sulphate solution at different concentrations using Quincke's method
20. To understand the Barkhausen effect on ferromagnetic material.
21. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer
22. *To determine radius of a current carrying coil using Tangent Galvanometer.

Suggested Books

1. Geeta Sanon: B. Sc. Practical Physics, 1st Edn. (2007), R. Chand & Co.
2. B. L. Worsnop and H. T. Flint: Advanced Practical Physics, Asia Publishing House, New Delhi.
3. Indu Prakash and Ramakrishna: A Text Book of Practical Physics, Kitab Mahal, New Delhi.
4. D. P. Khandelwal: A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Course Outcomes: After completion this, student shall be able to

CO1: Understand the functioning of various components, and learn to calculate the unknown resistance and coefficients of given circuits.

CO2: Learn the variation of voltage and current in a circuit consisting of multiple elements.

CO3: Understand the mechanism of generating magnetic fields, and understand the properties of magnetic field

CO4: Identify and calculate the properties and behavior of magnetic substances.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAMOUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M	H	M	H	M				
CO2	H	L		M	L				L
CO3	M	H	L	L					
CO4		M	H	M					L

H = Highly Related; M = Medium L = Low

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Dr. Pravin Kumar

SEMESTER - II

(CORE COURSES)

THERMODYNAMICS & STATISTICAL PHYSICS

CODE: BPH064A **CREDIT: 4**

UNIT-I

Laws of Thermodynamics: Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Reversible and Irreversible Changes. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot Cycle. Carnot Engine and its Efficiency. Refrigerator and its Efficiency. Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

UNIT-II

Entropy: Change in Entropy, Entropy of a State, Clausius Theorem. Clausius Inequality. Second Law of Thermodynamics in terms of Entropy. Entropy of a Perfect Gas. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Impossibility of Attainability of Absolute Zero: Third Law of Thermodynamics. Temperature-Entropy Diagrams. First and second order Phase Transitions.

UNIT-III

Thermodynamic Potentials: Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials U, H, F and G: Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work. Cooling due to Adiabatic demagnetization. Approach to Absolute Zero.

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.

UNIT-IV

Classical Statistics: Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space,Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature.

UNIT-V

Quantum Statistics: Bose-Einstein Statistics: B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description). **Fermi-Dirac Statistics:** Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals.

Suggested Books

1. Enrico Fermi: Thermodynamics, Courier Dover Publications, 1956.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
3. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.

Prof. A.C. Vijay

(Dr. Nishant Sarvaiya)

Dr. Pranav Soni

Chandan Joshi

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(Dr. Abhishek Shukla)

6. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
7. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
8. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer

Course Outcomes: After completion the course, student shall be able to

CO1: Comprehend the basic concepts of thermodynamics, and apply various laws of thermodynamics to various processes and real systems.

CO2: Ability to evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process and other important thermodynamic properties.

CO3: Understand the thermodynamic potentials and their physical interpretations, Maxwell's thermodynamic relations for various processes

CO4: Understand the fundamentals of thermodynamic system with their distinguishably or indistinguishably nature, the Gibbs paradox, equipartition of energy and concept of negative temperature.

CO5: Understand the application of BE and FD statistical distribution law to understand macroscopic properties of degenerate systems.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAMOUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L		M					L
CO2		H	L	M					M
CO3	M		M						
CO4	H	L		M					
CO5	M	L		H				L	M

H = Highly Related; M = Medium L = Low

THERMODYNAMICS AND STATISTICAL LAB

CODE: BPH065A **CREDIT:1**

Student has to perform / learn any ten experiments out of the following experiments:-

1. To study adiabatic changes using Clement and de-Sorme experiment.
2. To determine the mechanical equivalent of heat (J) by Electrical method (Joule's Calorimeter)
3. To verify Newton's cooling law of different materials and different liquid.
4. To determine mechanical equivalent of heat, J, by Callender and Barne's constant flow method.
5. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
6. To study the variation of Thermo-Emf of a thermocouple with difference of temperature of its two junctions.
7. To study the phase change
8. To study the heat transfer by radiations of various test elements
9. To find the thermal conductivity of a material by the two slab guarded hot plate method
10. To determine the thermal resistivity of the sample

11. To verify Newton's cooling law of different materials and different liquid and draw the cooling curve
12. To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method and determine the value of Nusselt number
13. *To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
14. *To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.

Suggested Books

1. B. L. Worsnop and H. T. Flint: Advanced Practical Physics, Asia Publishing House, New Delhi.
2. Indu Prakash and Ramakrishna: A Text Book of Practical Physics, Kitab Mahal, New Delhi.
3. D. P. Khandelwal: A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Course Outcomes: After completion this course, student shall be able to

CO1: Understand the basic concepts of thermodynamic such as temperature, pressure, system, properties, process, state, cycles and equilibrium.
CO2: Conduct experiments regarding the measurement and calibration of temperatures and pressures in groups.
CO3: Identify the properties of substances on property diagrams and obtain the data from property tables.
CO4: Learn energy transfer through mass, heat and work for closed and control volume systems.
CO5: Learn the application of first Law of Thermodynamics on closed and control volume systems.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L							
CO2		H	L	M					
CO3	M								L
CO4	L	H		L					M
CO5	M	H		M					M

H = Highly Related; M = Medium L = Low

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Dr. Pawan Sedha

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(Dr. Abhishek Thakur)

MATHEMATICAL PHYSICS & RELATIVITY

CODE: BPH066A **Credit: 5 (4L+1T)**

UNIT-I

Vector Calculus: Vector Differentiation. Scalar and Vector Fields. Ordinary and Partial Derivative of a Vector w.r.t. coordinates. Space Curves. Unit Tangent Vector and Unit Normal Vector (without Frenet- Serret Formulae). Directional Derivatives and Normal Derivative. Gradient of a Scalar Field and its Geometrical Interpretation. Divergence and Curl of a Vector Field. Del and Laplacian Operators. Vector Identities.

Vector Integration: Ordinary Integral of Vectors. Line, Surface and Volume Integrals. Flux of a Vector Field. Gauss' Divergence Theorem, Green's Theorem and Stokes Theorem.

UNIT-II

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

UNIT-III

Differential Equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Particular Integral.

Calculus of Variations

Variational Calculus: Variational Principle. Concept of Lagrangian. Generalized Coordinates. Definition of Canonical Momenta. Euler-Lagrange's Equations of Motion and its Applications to Simple Problems.

UNIT-IV

Tensors: Transformation of co-ordinates. Einstein's Summation Convention. Relation between Direction Cosines. Tensors: Algebra of Tensors, Sum, Difference and Product of Two Tensors, and Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Pseudotensors. Invariant Tensors: Kronecker Delta.

UNIT-V

The Idea of Space-Time and Minkowski Space. Geometry of Space-time, space like and time-like interval, Light Cone. Null-Cone representation. Metric Tensor. Four Vector Formalism: Four Velocities, Four Momenta. Transformation of Energy and Momentum

Special Theory of Relativity: Galilean Transformations. Postulates of STR. Lorentz Transformations, Simultaneity, Length Contraction. Time Dilation, Twin Paradox. Relativistic Transformation of Velocity, Relativistic Addition of Velocities. Frequency and Wave Number.

Mass-Energy equivalence principle. Variation of Mass with Velocity. Relativistic relation between energy and momentum. Relativistic Doppler effect. Relativistic Kinematics.

Suggested Books

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier..
2. L. A. Pipes: Applied Mathematics for Engineers & Physicists, McGraw Hill.
3. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
4. Fredrick W. Byron and Robert W. Fuller: Mathematics of Classical and Quantum Physics, Dover Publications.
5. Mathematical Physics, Goswami, 1st edition, Cengage Learning
6. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.
7. M. R. Spiegel: Vectors Analysis, Schaum's Outline Series.
8. David J. Griffiths: Introduction to Electrodynamics, Benjamin Cummings, 1998 (Also, PHI).

Prof. V.K. Vijay

Dr. Nishant Rana

Dr. Pramod Sharma

(Dr. Chandan Joshi)

(Dr. Abhishek Dhar)

9. Arthur Beiser: Prospects in Modern Physics, McGraw-Hill Book Company (1998).

Course Outcomes: After completion this course, students should be able to:

CO1: Learn the basic mathematical structures of vector calculus in solving the problems in various branches of Physics as well as in engineering

CO2: Understand and learn the Curvilinear coordinates to analyze the applications in problems with spherical and cylindrical symmetries.

CO3: Learn the representations and dynamics by partial differential equations and variational principle in solving mathematical problems arising in physics by a variety of mathematical techniques

CO4: Use the mathematical formalism for connections and general tensors to solve problems of general relativistic nature

CO5: Acquire the knowledge of light cone, null cone, four vector formalism, understanding of the special theory of relativity and able to perform basic calculations in relativistic kinematics.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M		L	M				H
CO2	M		H	M					
CO3	M	H				M		M	L
CO4	H	M	M		H				
CO5	M	H	L	M			L		

H = Highly Related; M = Medium L = Low

ELEMENTS OF MODERN PHYSICS

CODE: BPH067A **CREDIT: 4**

UNIT -I

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De-Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

UNIT-II

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle: Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction.)

UNIT - III

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic

particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

UNIT-IV

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimension across a step potential & rectangular potential barrier.

UNIT-V

Lasers: Induced Absorption, Spontaneous and Stimulated emissions, Relationship between Einstein's Coefficients, Principle of Lasing. Metastable State, Optical Pumping and Population Inversion. Components of Laser, Three-Level and Four-Level Lasers. Ruby Laser, He-Ne Laser and Diode laser.

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms, Applications of Holography

Suggested Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Course Outcomes: After completion this course, student shall be able to

CO1: Understand the development of quantum mechanics and ability to discuss and interpret experiments that reveal the quantum nature and dual nature of matter.

CO2: Understand the theory of quantum measurements, wave packets and uncertainty principle.

CO3: Understand the central concepts of quantum mechanics in the formulation of Wave function and the Schrodinger wave equation.

CO4: Formulate the basic theoretical problems e.g. one dimensional rigid box, tunneling through potential barrier, step potential, rectangular barrier

CO5: Understand the basics of lasing and working of different lasers, and learn the technique of Holography.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAMOUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		M	H	M	L			M
CO2	H		H	H					
CO3	H	L	M	L	M				
CO4	H	M	H	M					M
CO5	H	H	H	M	M	H	L	M	H

H = Highly Related; M = Medium L = Low

Prof Y.K. Vijay

(Dr. Nishant Saini)
Dr Pravar Sinha

Chandan Joshi
(Dr. Chandan Joshi)

ELEMENTS OF MODERN PHYSICS LAB

CODE: BPH068A **CREDIT:1**

Student has to perform / learn any eight experiments out of the following:-

1. To determine the Planck's constant using LEDs of at least 4 different colours.
2. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
3. To determine the wavelength of laser source using diffraction of single and double slits.
4. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
5. To experimentally demonstrate the concept of quantization of energy levels according to Bohr's model of atom.
6. To study the phenomenon of Photoelectric effect as a whole; (a) To draw kinetic energy of photoelectrons as a function of frequency of incident radiation, (b) To determine the Planck's constant from kinetic energy versus frequency graph, (c) To plot a graph connecting photocurrent and applied potential, (d) To determine the stopping potential from the photocurrent versus applied potential graph.
7. To study the emission spectra of Hydrogen, Neon and mercury vapours.
8. To experimentally demonstrate the concept of Millikan's oil drop experiment. (a) To find the terminal velocity of the drop, (b) To find the charge on a drop.
9. To determine the wavelength of a laser using the Michelson interferometer.
10. *To determine work function of material of filament of directly heated vacuum diode.
11. *To determine the ionization potential of mercury.
12. *To determine the absorption lines in the rotational spectrum of Iodine vapour.
13. *To show the tunneling effect in tunnel diode using I-V characteristics.

Reference Books

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Course Outcomes: Student shall be able to

CO1: Understand and verify the concept of quantization and quantized energy.
CO2: Learn the properties of Laser and understand the operating principle of some optical instruments.
CO3: Understand and illustrate the photo-electric effect by performing the various aspects.
CO4: Get an ability to illustrate the determination of charge of an electron.
CO5: Understand the process of work function, ionization, absorption with experiments to analyse the results.

Prof. Y.K. Vijay

(Dr. Nishant Kaur)

Dr Ramandeep

(Dr. Abhishek Sharma)

Chandan Joshi

(Dr. Chandan Joshi)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M		H	L					
CO2	M	H		L	M				M
CO3	M	H	M	M					
CO4	H	M		L	M				L
CO5	H		M	M					L

H = Highly Related; M = Medium L = Low

WAVES & VIBRATIONS

CODE: BPH069A **CREDIT: 4**

UNIT-I

Oscillations in Arbitrary Potential Well: Simple Harmonic Oscillations. Differential Equation of SHM and its Solution. Amplitude, Frequency, Time Period and Phase. Velocity and Acceleration. Kinetic, Potential and Total Energy and their Time Average Values. Reference Circle. Rotating Vector Representation of SHM.

Free Oscillations of Systems with One Degree of Freedom: (1) Mass-Spring system, (2) Simple Pendulum, (3) Torsional Pendulum, (4) Oscillations in a U-Tube, (5) Compound pendulum: Centres of Percussion and Oscillation, and (6) Bar Pendulum.

UNIT-II

Driven Oscillations: Damped Oscillations: Damping Coefficient, Log Decrement.

Forced Oscillations: Transient and Steady States, Amplitude, Phase, Resonance, Sharpness of Resonance, Power Dissipation and Quality Factor. Helmholtz Resonator.

Coupled Oscillators: Normal Coordinates and Normal Modes. Energy Relation and Energy Transfer. Normal Modes of N Coupled Oscillators.

UNIT-III

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid, in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

UNIT-IV

Elastic Waves in Solid Rod. Pressure Waves in Glass Columns. Transverse Waves in Strings. Waves in Three Dimensions. Spherical Waves. Plane Electromagnetic Waves. Energy and Momentum of Plane EM Waves. Radiation Pressure. Radiation Resistance of free space. EM Waves in dispersive Media. Spectrum of EM Waves.

UNIT-V

Ultrasonics: Production of ultrasonic waves. Echo; Reverberation, reverberation time, Sabine"s formula, remedies over reverberation; Absorption of sound, absorbent materials; Conditions for good acoustics of a building; Noise, its effects and remedies. **Piezoelectric effect**. Detection of ultrasonic waves: Piezoelectric detector. Kundt's tube method. Sensitive flame method. Thermal

detector method. Properties of ultrasonic waves. Cavitation. Acoustic grating. Velocity measurements.

SONAR: Non-destructive testing. Pulse echo technique. Transmission technique. Resonance. Medical Applications: Echocardiograms/Sonogram. Ultrasonic Imaging (Scan display).

Suggested Books

1. A. P. French: Vibrations and Waves, CBS Pub. & Dist., 1987.
2. N.K. Bajaj, The Physics of Waves and Oscillations, Tata Mc-Graw Hill Education (1988)
3. H.J. Jain, The Physics of Vibrations andWaves, Sixth Edition, Wiley (2005)
4. R.N. Chaudhari, Waves and Oscillations, New Age International (P) Ltd., (2010)
5. K. Uno Ingard: Fundamentals of Waves & Oscillations, Cambridge University Press, 1988.
6. Daniel Kleppner and Robert J. Kolenkow: An Introduction to Mechanics, McGraw-Hill, 1973.
7. Franks Crawford, Waves: Berkeley Physics Course (SIE), Tata McGrawHill, 2007.
8. M. S. Seymour Lipschutz: Schaum's Outline of Vector Analysis, McGraw-Hill, 2009.

Course Outcomes: After completion this course, student shall be able to

CO1: Learn the fundamentals of oscillating system having one degree of freedom.

CO2: Understand the concept of resonance and the response of a system (amplitude and phase, power dissipation) as a function of driving force, coupled oscillating system.

CO3: Understand the nature of waves, relationship between the velocity and physical properties of waves and different modes of vibration in stretched string / fluid or in pipe.

CO4: Understand the types of waves, propagation of EM waves in mediums.

CO5: Understand the concept and characteristics of ultrasonic, detection methods and its applications.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	M					
CO2	H	M	M	H	L				M
CO3	H	M	H	H					M
CO4	M		H		L				
CO5	H	M	M	L					M

H = Highly Related; M = Medium L = Low

WAVES AND VIBRATIONS LAB

CODE: BPH070A **CREDIT: 1**

Student has to perform / learn any ten experiments out of the followings:

1. To calculate the natural frequency and damping ratio of a spring-mass system, experimentally; and compare the results with theoretical values.
2. To calculate the natural frequency and damping ratio for free vibration of a single DOF cantilever beam with a lumped mass at free end, experimentally; and compare the results with theoretical values.

3. To calculate the natural frequency and damping ratio for forced vibration of a single DOF cantilever beam with a lumped mass at free end, experimentally; and compare the results with theoretical values
4. To study the Simple Harmonic motion
5. To study simple Damped Harmonic Oscillations
6. To Study Coupled Simple Harmonic Motion
7. To study Nonlinear Oscillations
8. To study Nonlinear Damped Oscillations
9. To study the LC circuit
10. To Study LCR circuit and resonance behavior of circuit.
11. To find the velocity of sound waves in a given rod with Kundt's tube apparatus and also find the Young's modulus of the material of the rod.
12. To calculate the velocity of ultrasonic sound through different liquid media using ultrasonic interferometer
13. To calculate the adiabatic compressibility of the given liquid ultrasonic interferometer
14. To determine the frequency of an electrically maintained tuning fork by, (a) Transverse mode of vibration, (b) Longitudinal mode of vibration

Suggested Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

Course Outcomes: After completion this course, student shall be able to

CO1: Develop an understanding of various aspects of harmonic oscillations and waves specially.
CO2: Acquire the knowledge of superposition of collinear and perpendicular harmonic oscillations
CO3: Understand the dynamics of various types of mechanical waves and their superposition.
CO4: Learn the characteristic behavior of coupled, forced and driven oscillators and thereby able to illustrate the Lissajous figures.
CO5: Understand the properties of Ultrasonic waves through the experiments.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H			M					
CO2	H	L		M	L				M
CO3		H	M	L					
CO4	L	M	M	M	M				L
CO5	H		L	M	L				M

H = Highly Related; M = Medium L = Low

Prof. V.K. Vijay

(Dr. Nishant Rana)
Dr Pranav Sharma.

Chandan Joshi
(Dr. Chandan Joshi)

(Dr. Alisha Khosla)

SEMESTER – III

(CORE COURSES)

ADVANCED MATHEMATICAL PHYSICS

CODE: BPH071A **CREDIT: 4**

UNIT-I

Dirac-delta function and its properties:

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.

UNIT-II

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.

UNIT-III

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x)) and Orthogonality.

UNIT-IV

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. Least-squares fit. Error on the slope and intercept of a fitted line.

UNIT-V

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes. Diffusion Equation.

Reference Books

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
7. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

Course Outcomes

After completion this course, student shall be able to-

CO1: Learn the Dirac delta function its properties, which have applications in various branches of Physics, especially in quantum mechanics

CO2: Understand the Fourier analysis of periodic functions and their applications in physical problems such as vibrating strings etc.

CO3: Understand about the special functions, differential equations and their applications in various physical problems in quantum mechanics.

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(Dr. Nishant Varma)

(Dr. Chandan Joshi)

(Dr. Abhishek Negi)

CO4: Understand the beta, gamma and error functions and their applications in doing integrations; learn the basics of errors, their analysis.

CO5: Acquire knowledge of methods to solve partial differential equations with the examples of important partial differential equations in Physics.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M	L			H			L
CO2		H	M	M					L
CO3	M	H		M			L		
CO4	M		M	H					M
CO5	M	H	L		M				

H = Highly Related; M = Medium L = Low

ADVANCED MATHEMATICAL PHYSICS LAB

CODE: BPH072A **CREDIT: 1**

Review of C & C++ Programming fundamentals: Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. Loop-While, Do-While & FOR Loop. Break and Continue Statements. Nested Loops), Arrays (1D & 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects

Programs: Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search Random number generation Area of circle, area of square, volume of sphere, value of pi (π)

Introduction to Numerical Computation Software Scilab: Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).

Generating and plotting of Special functions Legendre Polynomials and Bessel function using User defined functions in Scilab

(Dr. P.K. Vijay) (R. Nishant Kaur) (Dr Pranav Sexena) (Dr. Chandan Joshi) (Dr Abhishek Sharma)

Solution of ODE First order Differential equation Euler:- Radioactive decay, Current in RC, LC circuits with DC source, Newton's law of cooling, Classical equations of motion
Partial Differential Equation- Wave Equation, Heat Equation, Poison Equation, Laplace Equation Using Scicos/xcos - Generating Square Wave, Saw-tooth Wave, Sine Wave, Solution of Harmonic Oscillator, Study of beat phenomena and Phase space plots.

Using C++ /Scilab based simulations experiments based on Mathematical Physics problems-
Examples:

1. Dirac-Delta function: Evaluate $\frac{1}{\sqrt{2\pi\alpha^2}}\int e^{\frac{-(x-2)^2}{2\sigma^2}}(x+3)dx$ for $\sigma = 1, 0.1, 0.01$ and show it tends to 5.
2. Fourier Series: Program to sum $\sum_{n=1}^{\infty} 0.2^n$ and Evaluate the Fourier coefficients of agiven periodic function (Square Wave).
3. Frobenius Method and Special Function: $\int_{-1}^{1} P_n(\mu)P_m(\mu)d\mu = \delta_{n,m}$. Plot $Pn(x)$, $j_v(x)$ and show recursion relations.
4. Calculation of error for each data point of observations recorded in experiments done (choose any two).
5. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program
6. Evaluation of trigonometric functions e.g. *sin θ*, Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration.
7. Compute the nth roots of unity for $n = 2, 3$, and 4.
8. Find the two square roots of $-5+12j$.
9. Solve Kirchoff's Current law for any node of an arbitrary circuit using Laplace's transform.
10. Solve Kirchoff's Voltage law for any loop of an arbitrary circuit using Laplace's transform
11. Perform circuit analysis of a general LCR circuit using Laplace's transform
12. Solve differential equations:
    a. $\frac{dy}{dx} = e^{-x}$ with y=0 and x=0
    b. $\frac{dy}{dx} + e^{-x}y = x^2$
    c. $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = -y$
    d. $\frac{d^2y}{dt^2} + e^{-t\frac{dy}{dt}} = -y$
13. The differential equation describing the motion of a pendulum is
    $\frac{d^2\theta}{dt^2} = -\sin^2\theta$

Prof Y.K. Vijay
Dr Nishant Saini
Dr Pranav Saxena
Chandan Joshi
(Dr. Chandan Joshi)

The pendulum is released from rest at an angular displacement α, i.e. $\theta(0) = \alpha$ and $\theta'(0) = \alpha$. Solve the equation for $\alpha = 0.1$, 0.5 and 1.0 and plot θ as a function of time in the range $0 \leq t \leq 8\pi$.

Reference Books

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. Computational Physics, D.Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.
4. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
5. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
6. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
7. Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
8. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing
9. www.**scilab**.in/textbook_companion/generate_book/291

Course Outcomes: After completion this course, student shall be able to -

CO1: Learn the basics fundamentals of C & C++ programming.

CO2: Learn the basics and programming in Scilab software, their utility, advantages and disadvantages.

CO3: Apply the Scilab software in curve fittings, in solving system of linear equations, generating and plotting special functions such as Legendre polynomial and Bessel functions

CO4: Apply the Scilab software for solving first and second order ordinary and partial differential equations to understand the wave analysis of the system.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L	H	H	M				
CO2	M	H	M	L		L			M
CO3	H	H	M	M	L			L	
CO4	L	M	H	L			M		

H = Highly Related; M = Medium L = Low

CIRCUIT ANALYSIS AND BASIC ELECTRONICS

CODE: BPH073A **CREDIT: 4**

UNIT-I

Electrical circuit elements: voltage and current sources, R, C, L, M, I, V, linear, non linear, active and passive elements, inductor current and capacitor voltage continuity, Kirchhoff's laws, Elements in series and parallel, superposition in linear circuits, controlled sources, energy and power in elements, energy in mutual inductor and constraint on mutual inductance.

Prof Y.K. Vijay (Dr. Nishant Gaur) (Dr. Abhishek Shukla)
Dr. Pramod Sexena Chandan Joshi
(Dr. Chandan Joshi)

UNIT-II

Network analysis: Nodal analysis with independent and dependent sources, modified nodal analysis, mesh analysis, notion of network graphs, nodes, trees, twigs, links, co-tree, independent sets of branch currents and voltages.

UNIT-III

Network theorems: Voltage Shift Theorem, Zero Current Theorem, Tellegen's Theorem, Reciprocity, Substitution Theorem, Thevenin's and Norton's theorems, pushing a voltage source through a node, splitting a current source, compensation theorem, maximum power transfer.

UNIT-IV

Semiconductors: Intrinsic and extrinsic semiconductors, Energy Level Diagram. Conductivity and Mobility, carrier statistics, and thermal equilibrium carrier concentration.

Excess carriers in semiconductors: Excess carriers, lifetime, and carrier transport by drift and diffusion; Continuity equation and its solution under different injections; Solution of diffusion equation in uniformly doped base long and short base limits.

UNIT-V

Theory of PN junctions: p and n Type Semiconductors.. pn Junction Fabrication (Simple Idea). Barrier Formation in pn Junction Diode. Current Flow Mechanism in Forward and Reverse Biased Diode (Recombination, Drift and Saturation of Drift Velocity). Derivation of Mathematical Equations for Barrier Potential, Barrier Width and Current for Step Junction. P-N junction and its characteristics. Static and Dynamic Resistance. Diode Equivalent Circuit. Ideal Diode. Load Line Analysis of Diodes. Load Line and Q-point

Suggested Books

1. Basic and Applied Electronics-T.K Bandyopadhyay, Books and Allied Pvt Ltd (2002)
2. V.K.Mehta, "Principles of Electronics", S.Chand & Co
3. B.L.Theraja, "Basic solid state Electronics", S.Chand &Co
4. R. L. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, Pearson Education (2006).
5. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
6. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning.
7. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill

Course Outcomes: After completion this course, student shall be able to

CO1: Apply Kirchhoff's rules to analyze the circuits consisting of parallel and/or series combinations of voltage sources and resistors and understand their graphical relationship.

CO2: Acquire the knowledge of important terminology like nodes, trees, twigs, links, co-tree, independent sets of branches in a complex circuit.

CO3: Demonstrate and learn various network theorems and their applications in electrical circuit and electronics.

CO4: Learn and understand the basics of semiconductors and the role of diffused charged carriers in changing the properties.

CO5: Demonstrate the current flow mechanism, nature of potential barrier and understand the characteristics of diode by calculating the dynamical variables.

Prof. Y.K. Vijay

Dr. Nishant Gaur

Dr Kranav Sisodia

Chandan Joshi (Dr. Abhishek Sha

(Dr. Chandan Joshi)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M		L	L				L
CO2	M	H	M						
CO3	L		H	M	L		L		M
CO4	H	M		L					
CO5	M		H	M			L		

H = Highly Related; M = Medium L = Low

CIRCUIT ANALYSIS AND BASIC ELECTRONICS LAB

CODE: BPH074A **CREDIT: 1**

Student has to perform / learn any ten experiments out of the followings:-

1. Verification of Kirchhoff's current law and voltage law using hard ware and digital simulation.
2. Verification of mesh analysis using hard ware and digital simulation.
3. Verification of nodal analysis using hard ware and digital simulation
4. Determination of average value, rms value, form factor, peak factor of sinusoidal wave, square wave using hard ware and digital simulation.
5. Verification of super position theorem using hard ware and digital simulation.
6. Verification of reciprocity theorem using hardware and digital simulation.
7. Verification of maximum power transfer theorem using hardware and digital simulation
8. Verification of Thevenin's theorem using hard ware and digital simulation
9. Verification of Norton's theorem using hard ware and digital simulation
10. Verification of compensation theorem using hard ware and digital simulation
11. Verification of self inductance and mutual inductance by using hard ware.
12. Verification of series resonance using hard ware and digital simulation
13. Verification of parallel resonance using hard ware and digital simulation.
14. Study the diode clipping circuits on breadboard, using discrete components for peak clipping and peak detection. i) Positive and Negative Clipping Circuit, ii) Diode series positive and negative Clipping Circuit.

Course Outcomes: After completion this course, student shall be able to

CO1: Learn the role of Kirchoff's Law in understanding the distribution of voltage and currents in electric circuits.
CO2: Acquire the knowledge to distinguish the circuits on the basis of Node and Mesh analysis.
CO3: Demonstrate the theorems to analyze the network circuits through physical and simulations.
CO4: Test the properties of parallel and series circuits containing the discrete components.

Prof. Y.K. Vijay
(Dr. Nishant Gaur)
(Dr. Abhishek Shukla)
(Dr. Chandan Joshi)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M		M					
CO2		H	M	L					
CO3	H	M		H	M				M
CO4		M	H		L				M

H = Highly Related; M = Medium L = Low

Dr Pravan Saxena

(Dr Abhishek Sharma)

Prof. Y.K Vijay

(Dr. Nishant Gaur)

Chandan Joshi

(Dr. Chandan Joshi)

SEMESTER - IV

(CORE COURSES)

SOLID STATE PHYSICS

CODE: BPH017B **CREDIT:4**

UNIT-I

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Types of Bonds. Ionic Bond. Covalent Bond. Van der Waals Bond. Diffraction of x-rays by Crystals. Bragg's Law, Atomic and Geometrical Factor.

UNIT-II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Einstein and Debye Theories of Specific Heat of Solids. T^3 Law.

UNIT-III

Dielectric Properties of Materials: Dielectric Polarization. Local Electric Field at an Atom. Depolarization Field. Dielectric Constant. Electric Susceptibility. Polarizability. Classical Theory of Electric Polarizability. Clausius- Mosotti Equation. Normal and Anomalous Dispersion. Complex Dielectric Constant.

UNIT-IV

Band Theory of Solids: Bloch Theorm. Kronig-Penney Model. Effective Mass of Electron, Concept of Holes, Band Gaps. Energy Band Diagram and Classification of Solids. Law of Mass Action. Insulators and Semiconductors (P type and N type). Direct and Indirect Band Gap. Conductivity in Semiconductors, mobility, Hall Effect, Measurement of conductivity (4- probe method) and Hall coefficient.

UNIT-V

Magnetic Materials: Dia-, Para-, Ferri- and Ferromagnetic Materials, Classical Langevin Theory of dia– and Paramagnetic Domains, Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains, Discussion of B-H Curve, Hysteresis and Energy Loss

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation).

Suggested Books

1. Charles Kittel: Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc.
2. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, Rita John, 2014, McGraw Hill
5. A. J. Dekkar: Solid State Physics, Macmillan India Limited, 2000.
6. J. S. Blackmore: Solid State Physics, Cambridge University Press, Cambridge.
7. N. W. Ascroft and N. D. Mermin: Solid State Physics, (Harcourt Asia, Singapore 2003).

Course outcomes:- After completion this course, students shall be able to-

CO1: Understand about crystalline and amorphous substances, about lattice structure, concept of Brillouin zones and diffraction of X-rays by crystalline materials.

CO2: Understand the knowledge of lattice vibrations, phonons and in depth of knowledge of Einstein and Debye theory of specific heat of solids.

CO3: Acquire the essence of dielectric properties of materials.

CO4: Demonstrate the formation of bands in solids, and their classification into insulators, conductors and semiconductors, and Hall effects.

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CO5: Understand the basics of superconductors. Type I and II superconductors, their properties and physical concept of BCS theory.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L		M	L				
CO2	M								
CO3	M	L	M	H					M
CO4	H		M	M	L				M
CO5	L	M		M					L

H = Highly Related; M = Medium L = Low

SOLID STATE PHYSICS LAB

CODE: BPH075A **CREDIT: 1**

Student has to perform / learn any eight experiments out of the followings:-

1. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150^0C) and to determine its band gap.
2. To determine the Hall coefficient of a semiconductor sample.
3. Determine the Bandgap of a semiconductor
4. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
5. To study various crystal structures
6. To find the elastic constants of the Perspex beam using Cornus interference method. (i) Young's modulus(Y), (ii) Poisons ratio (σ) , (iii) Bulk modulus (b)
7. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer
8. To determine the volume magnetic susceptibility of Manganese sulphate solution at different concentrations by Quincke's method.
9. To measure the dipole moment of gaseous and liquid substances using dipolemeter.
10. Estimation of precise lattice parameters of cubic crystal
11. To gain the knowledge of various techniques for structural characterization of materials
12. *To measure the Magnetic susceptibility of Solids.
13. *To measure the Dielectric Constant of a dielectric Materials with frequency
14. *Study the Bragg's Law.

Suggested Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn., 2011, Kitab Mahal

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4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

Course Outcomes: After completion this course student shall be able to-

CO1: Learn the techniques to determine the properties of semiconductors.
CO2: investigate the crystal structures and properties of solids
CO3: Acquire the knowledge to measure the magnetic susceptibility of magnetic materials and magnetic hysteresis.
CO4: Demonstrate the four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L	L						L
CO2		H		M					L
CO3	H	M	L		M				
CO4		H		M	M				

H = Highly Related; M = Medium L = Low

NUCLEAR AND PARTICLE PHYSICS

CODE: BPH021B **CREDIT: 5 (4L+1T)**

UNIT-I

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

Radioactivity decay: (a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.

UNIT-II

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

UNIT-III

Nuclear Reactions and Interaction with matter: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Elementary Idea of (i) Gamma ray interaction through matter, (ii) photoelectric effect, (iii) Compton scattering, (iv) pair production, (v) neutron interaction with matter.

UNIT-IV

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT) and neutron detector.

Particle Accelerators: Accelerator facility available in India: Van-de Graaff Generator (Tandem Accelerator), Linear accelerator, Cyclotron, Synchrotrons.

UNIT-V

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm.

Suggested Books:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
5. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
6. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
7. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOPInstitute of Physics Publishing, 2004).
8. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
9. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
10. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)

Course Outcomes: After completion this course, student shall be able to-

CO1: To describe and explain the properties of nuclei and derive the various theoretical formulation of nuclear disintegration.

CO2: Understand semi empirical mass relation and about the nucleus structure through various models.

CO3: Develop basic understanding of the interaction of various nuclear radiations with matter in low and high energy.

CO4: Understand, construct and operate simple detector systems for nuclear radiations and training to work with various types of nuclear accelerators.

CO5: Demonstrate basic knowledge of elementary particles as fundamental constituent of matter, their properties, and conservation laws during their interactions with matter.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M		L	H					L
CO2	L								
CO3	H	L	L	M					M
CO4	M	H	M						
CO5	H		M	M					M

H = Highly Related; M = Medium L = Low

SEMESTER – V

(CORE COURSES)

QUANTUM MECHANICS

CODE: BPH014B **CREDIT: 4**

UNIT-I

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

UNIT-II

Time independent Schrodinger equation: Hamiltonian, stationary states and energy eigen values; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Position-momentum uncertainty principle.

UNIT-III

Bound States in an Arbitrary Potential: continuity of wavefunction, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.

UNIT-IV

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wave functions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells.

UNIT-V

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Atoms in External Magnetic Fields:- Qualitative Discussion: Normal and Anomalous Zeeman Effect, Paschen Back and Stark Effect.

Suggested Books:

1. A Text book of Quantum Mechanics, P.M. Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
6. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
7. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press

Prof. Y.K. Vijay

(Dr. Nishant Rana)

Dr Pramod Sharma

(Dr. Chandan Joshi)

(Dr. Abhishek Shyam)

Course Outcomes: After completion this course, student shall be able to-

CO1: Explain the microscopic phenomena, quantum theory formulation through Schrodinger equation, and understand the Operator Mechanism in Quantum Mechanics

CO2: Interpret the wave function of quantum particle and probabilistic nature of its location, construction of Gaussian wave packet.

CO3: Demonstrate the quantum behavior of a particle under various potential conditions, phenomena of quantum harmonic oscillator in terms of Hermite polynomials.

CO4: Learn the techniques of separation of variables, and concept of theory of angular Momentum and its application to Hydrogen-like Atom for its spectrum analysis.

CO5: Interpret the influence of electric and magnetic fields on atoms in understanding Stark effect and Zeeman Effect respectively.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L	M						M
CO2	H	M	M	H					
CO3		H		M					L
CO4	H	M	M	M					L
CO5	M		L						

H = Highly Related; M = Medium L = Low

QUANTUM MECHANICS LAB

CODE: BPH076A **CREDIT: 1**

Student has to perform ten programs/simulations out of the followings:

1. To write programme to evaluate scalar potential due to electric charge.
2. To compute and plot electric potential due to two point charges.
3. To plot electric field vector due to electric charge(s).
4. To write programme to evaluate Schrödinger's equation of motion.
5. To write a program to calculate the energy eigen values for harmonic oscillator (first 3energies)
6. To write programme to evaluate Heisenberg's equation of motion.
7. To write a program to calculate probability of quantum mechanical tunneling.

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like-

8. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

   $\frac{d^2y}{dx^2} = A(r)u(r)$, where $A(r)=\frac{2m}{\hbar^2}[V(r)-E]$ and $V(r)=\frac{-e^2}{r}$

   Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 (eVÅ)1/2, hc = 1973 (eVÅ) and m = 0.511x10^6 eV/c2.
9. Solve the s-wave radial Schrodinger equation for an atom:

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$\frac{d^2y}{dx^2} = A(r)u(r)$, where $A(r) = \frac{2m}{\hbar^2}[V(r) - E]$ and $V(r) = \frac{-e^2}{r}e^{-r/a}$

where m is the reduced mass of the system (which can be chosen to be the mass of an electron). Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 (eVÅ)1/2, m = 0.511×10^6 eV/c2, and a = 3 Å, 5 Å, 7 Å. In these units hc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

10. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$\frac{d^2y}{dx^2} = A(r)u(r)$, where $A(r) = \frac{2m}{\hbar^2}[V(r) - E]$

For the anharmonic oscillator potential $V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$

for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c2, k = 100MeV fm-2, b = 0, 10, 30 MeV fm-3 In these units, ch = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.

11. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

Where μ is the reduced mass of the two-atom system for the Morse potential $V(r) = D(e^{-2\alpha r'} - e^{-\alpha r'})$, $r' = \frac{r - r_0}{r}$. Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take: m = 940×10^6 eV/C2, D = 0.755501 eV, α = 1.44, r_0 = 0.131349 Å

Suggested Books

1. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ. Press
2. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific &
3. Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer.
4. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
6. Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:978-6133459274

Course Outcomes: After completion this course, student shall be

CO1: Acquire the skill of doing computational programming using software and languages.

CO2: Demonstrate the nature of potential and fields due to a isolated charge by simulations.

CO3: Understand the fundamentals of quantum mechanics through simulations and able to demonstrate the techniques for estimating the ground state energy, wave functions and simple harmonic oscillator using Schrodinger equations.

CO4: Breakdown the quantum mechanical problems of one dimensional and three dimensional potentials, and Hydrogen like atoms.

Prof Y.K. Vijay

(Dr. Nishant Gaur)

Dr Ravi Kumar

(Dr. Chandan Joshi)

(Dr. Abhishek Sharma)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		H	M	M	H				M
CO2	L	H	L						
CO3		H	M	M	H				L
CO4		M	H	M	L				L

H = Highly Related; M = Medium L = Low

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Dr. Nishant Gaur

Dr. Abhishek Sharma

Prof Y.K. Vijay

Chandan Joshi

(Dr. Chandan Joshi)

SEMESTER - III

(DEPARTMENTAL ELECTIVES)

DIGITAL ELECTRONICS

CODE: BPH081A **Credits: 4**

UNIT I

Number System and Codes: Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, BCD code. Binary, octal and hexadecimal, BCD- Excess3,graycode-Alphanumeric codes.

UNIT II

Digital Logic Families: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, comparison of TTL and CMOS families. Truth Tables of OR, AND, NOT, NOR, NAND, EXOR, Universal Gates, Basic postulates and fundamental theorems of Boolean algebra. Demorgan's Theorem. Karnaugh Maps: Four variable K-Map, Tabular method (Queen-Mc Clusky method)

UNIT III

Arithmetic Circuits: Binary Addition. Half and Full Adder. Half and Full Subtractor, Binary Adder/Subtractor. Multiplexers, De-multiplexers, Decoders, Encoders. Parity checker – parity generators – code converters - Magnitude Comparator.

UNIT IV

Latches: Latches, Flip-flops - SR, JK, D, T, and Master-Slave -Edge triggering – Level Triggering Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.

UNIT V

Memory Devices: Memory Devices Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM – EAPROM, RAM – RAM organization – Static RAM Cell-Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

Suggested Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
2. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Digital Electronics G K Kharate ,2010, Oxford University Press
5. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning
6. Logic circuit design, Shimon P. Vingron, 2012, Springer.
7. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
8. Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill
9. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

Course Outcomes: After completion this course, student shall be able to-

CO1: Understand the basic knowledge of number system and codes to learn integrated circuits.

CO2: Demonstrate fundamental logic gates using of Boolean functions, and construction of digital circuits by employing Boolean algebra.

CO3: Understand the working of Multiplexers as data processing circuit, combinational circuits and sequential circuits and demonstrate Adders, Subtractors.

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Dr. Nishant Saini

Dr Pramod Sachan

Chandan Joshi

(Dr. Chandan Joshi)

Dr Abhishek Sharma

CO4: Acquire the knowledge about Flip Flop as a building bock, operation and uses of counters and registers in electronic devices.

CO5: Demonstrate the knowledge of various static and dynamic memory devices, and programmable logic devices.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	H	L	M	L	L	M		M
CO2	H	H	L	H	M		L		L
CO3	H	L	M	M	M				L
CO4		M	H	M	L			M	M
CO5	M	L	M	H	L	L	L	M	M

H=High; M=Medium; L=Low

DIGITAL ELECTRONICS LAB

CODE: BPH082A **Credit: 1**

Student has to perform any ten experiments out of the followings:

1. To test a Diode and Transistor using a Multimeter.
2. To design a switch (NOT gate) using a transistor.
3. To verify and design AND, OR, NOT and XOR gates using NAND gates.
4. To design a combinational logic system for a specified Truth Table.
5. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates
6. Construction of half / full adder using XOR and NAND gates and verification of its operation
7. To Study & Verify Half and Full Subtractor
8. Realization of logic functions with the help of universal gates NAND and NOR Gate
9. Construction of NOR gate latch and verification of its operation
10. Verify the truth table of RS, JK, T and D flip-flops using NAND & NOR gates
11. Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers
12. Implementation and verification of decoder/de-multiplexer and encoder using logic gates
13. Design and verify the 4- Bit Synchronous/ Asynchronous Counter using JK flip flop
14. To study (i)Architecture of ALU (ii) arithmetic and logical operations (Binary Half and Full- Adder and Subtractor)
15. To design and simulation of Arithmetic Logic units
16. To Design and Simulate binary to gray, gray to binary, BCD to Excess 3, Excess 3 to BCD code converters

Suggested Books:

1. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
2. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
3. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
4. Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI

Learning.

Course Outcomes: After completion this course, student shall be able to-

CO1: Verify the Boolean algebra, and its importance in understanding various fundamental logic gates and construction of these.

CO2: Test the Arithmetic circuits by various adder and subtractor and multiplexers using gates.

CO3: Learn about combinatorial and sequential systems using flip-flop circuits to understand the working of counters and registers.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M	M	L					M
CO2	M	H	L	M	L	M			
CO3	M	H	M	M	M				L

H=High; M=Medium; L=Low

STRUCTURE AND PROPERTIES OF MATERIALS

CODE: BPH083A **Credits: 4**

UNIT I

Structure of Solids: Overview of Crystal Structure, Solid Solutions-Hume Rothery Rules, Crystal Imperfections, Point Defects, Line Defects, Surface Defects, Bulk Defects, Critical nucleus size and Critical Free energy, Mechanism of Crystallisation, Homogeneous and Heterogenous Nucleation Growth, Single crystal, Polycrystalline Materials, Basic principles of solidification of metals and alloys.

UNIT II

Phase Diagrams: Phase Rule, Binary Phase diagrams, Isomorphous systems, congruent phase diagrams, Free energy composition curves, Construction, Microstructural changes during cooling, Typical Phase diagrams, Cu-Zn System, Pb-Sn system, Ag-Pt system, Iron-Iron carbide Equilibrium Diagram

UNIT III

Alloys: Classification of steels and cast iron, Microstructure, Effect of alloying elements on steel, Ferrous alloys and their applications, Factors affecting conductivity of a metal, Electrical Resistivity in alloys, Thermal conductivity of metals and alloys, High Resistivity alloys,

UNIT IV

Ceramics: Types, Crystal Structures, Silicate Ceramics, Glasses, Glass Ceramics, Functional properties and applications of ceramic materials (SiC, Al2O3, Si3N4), Super hard materials - Tungsten carbide and Boron nitrides – Graphene.

UNIT V

Polymers: Classification of polymer, Mechanisms of polymerization, Copolymers, Defects in polymers, Thermoplastics, Thermosets (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE), Overview: Liquid Crystal Polymers, Conductive polymers, High Performance fibres, Photonic polymers, Elastomers.

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Suggested Books:

1. V. Raghavan, "Materials Science and Engineering", Prentice –Hall of India Pvt. Ltd., 2007
2. Kingery, W. D., Bowen H. K. and Uhlmann, D. R., "Introduction to Ceramics", 2nd Edition, John Wiley & Sons, New York, 1976.
3. F. N. Billmayer, "Test Book of polymer science", John Wiley & Sons, New York, 1994.
4. William F. Smith, "Structure and Properties of Engineering Alloys", Mc-Graw-Hill Inc., U.S.A, 2nd edition, 1993.
5. W. Bolton, "Engineering materials technology", 3rd Edition, Butterworth & Heinemann, 2001

Course Outcomes: At the end of the course, the students will

CO1: To have the knowledge of overview crystal structures and mechanism of crystallization

CO2: Able to understand and classify the phase diagrams.

CO3: Able to recognize basic nomenclature, basic microstructure, and associate terms with the appropriate structure / phenomena.

CO4: To have the knowledge on structure properties correlation in ceramics

CO5: Able to understand the various polymers and its application.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	M					
CO2	M	H							
CO3	H	M	M	L	M				M
CO4	M	H	L						L
CO5	M	H	M		L				L

H = Highly Related; M = Medium L = Low

STRUCTURE AND PROPERTIES OF MATERIALS LAB

CODE: BPH084A **Credit: 1**

Student has to perform the following experiments:-

1. To determine the composition in vapour phase and plot graph between temperature and mole fraction to determine the relative volatility.
2. To study the phase change.
3. To determine and separate the constituents like Copper, Zinc, Tin, Lead, and Iron in brass.
4. To determine the melting point of the given substance and to find out the transition time.
5. To study the phase change of a substance from liquid to solid by plotting the cooling curve.
6. To observe the phases present in the microstructure of stainless steels

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7. Determine the absolute viscosity of Polymer solutions of different concentrations
8. Determine the viscosity average molecular weight of a polymer.

Suggested Books:

1. William F. Smith, "Structure and Properties of Engineering Alloys", Mc-Graw-Hill Inc., U.S.A, Second Edition, 1993.
2. William D. Callister, Jr., "Materials Science and Engineering an Introduction", Second Edition,
   John Wiley & Sons, Inc., 2007.
3. F. N. Billmayer, "Test Book of polymer science", John Wiley & Sons, New York, 1994

Course Outcomes: After completion this course, student shall be able to-
CO1: Learn the microstuctural properties of materials with respect to the temperature.
CO2. Demonstrate the knowledge of identifying the materials on its constituent's properties.
CO3: Analyze the changes in behavior of materials on transforming the phases.
CO4: Understand the properties of polymers.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		M		H					
CO2	H	L		M					M
CO3	M	H		L					M
CO4	H	L		L					L

H = Highly Related; M = Medium L = Low

INTRODUCTION TO ASTRONOMY AND ASTROPHYSICS

CODE: BPH085A **Credits: 4**

UNIT I

Astronomical Scales: Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature.

Basic Concepts of Positional Astronomy: Celestial Sphere, Geometry of a Sphere, Spherical Triangle, Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Calendar.

UNIT II

Sky Coordinates and Motions: Earth Rotation, Sky coordinates, seasons, phases of the Moon, the Moon's orbit and eclipses, timekeeping (sidereal vs synodic period); Planetary motions, Kepler's Laws, Gravity; Light & Energy, Telescopes, Optics, Detectors;

UNIT III

Basic Parameters of Stars and Spectral Properties: Determination of Distance by Parallax Method; Brightness, Radiant Flux and Luminosity, Apparent and Absolute magnitude scale,

Prof. V.K. Vijay
(Dr. Nishant Rawat)
Dr. Raman Kapoor
Chandan Joshi
(Dr. Chandan Joshi)

Distance Modulus; Process in interior of Stars. Spectral Lines and its consequences on stellar evolution

UNIT IV

The Solar Family: Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets.

UNIT V

Stellar Spectra and Classification Structure: Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification

Suggested Books

1. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing.
2. The Physical Universe: An Introduction to Astronomy, F.Shu, Mill Valley: University Science Books.
3. Fundamental of Astronomy (Fourth Edition), H. Karttunen et al. Springer
4. K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002.
5. Baidyanath Basu, 'An introduction to Astro physics', Second printing, Prentice -Hall of India Private limited, New Delhi,2001.
6. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication.

Course Outcomes:

After completion this course, student shall be able to-

CO1: Comprehend astronomical scales and understand basic concepts of positional Astronomy, basic parameters of stars like brightness, radiant flux, luminosity, magnitude, orbits.

CO2: Describe astronomical techniques, various types of optical telescopes and telescope mountings, various types of detectors and their use with telescopes.

CO3: Describe the Physics of sun, i.e. photosphere, chromosphere, corona, solar activity. Solar MHD, helioseismology

CO4: Understand the physics of solar system and its origin, Spectral classification, luminosity classification, temperature dependence and H-R diagram.

CO5: Get basic knowledge about the structure and properties of galaxies, Milky Way and Star clusters in Milky Way.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H			M	L			L	M
CO2		H	H	M	L				M
CO3	H	L	M	H				M	M
CO4	H	H		M	M				
CO5	H		M	H	L				M

H = Highly Related; M = Medium L = Low

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Dr. Nishant Rana V

Dr. Pranav Saxena

Chandan Joshi (Dr. Abhishek)

(Dr. Chandan Joshi)

HANDS ON PRACTICE LAB - I

CODE: BPH086A **Credit: 1**

STELLARIUM is a free open source planetarium for your computer. It shows a realistic sky in 3D, just like what you see with the naked eye, binoculars or a telescope. Stellarium can be downloaded for all operating systems like LINUX, Mc OSX, and Windows.

1. To become familiar with the astronomical objects visible to naked eye in the night sky using the software Stellarium.
   (i) Create a night sky map at different times.
   (ii) Identify astronomical objects such as planets, stars, nebula, milky way etc.
   (iii) Correlate the objects in the map with the directly observable night sky with naked eye.
2. To become familiar with the Constellations in the night sky using the software Stellarium: Identify the constellations at different times (10PM and 12Midnights)
3. Study of Solar spectrum: Identify some prominent spectral lines and determine the equivalent width
4. To get familiar with the spectra of different Stars.
5. To extract coordinates of a star assuming a telescope in equatorial mount.
6. To measure astronomical distances using Cepheid variables
7. To measure the distance using parallax method

Course Outcome: After completion this course, student shall be to

CO1: Acquire the skills of operating the software Stellarium and knowledge of interpreting the results.

CO2: Demonstrate the astronomical objects in Stellarium and understand the mapping of these in night sky.

CO3: Explain the spectral properties of Solar system and learn the concept of sidereal time.

CO4: Acquire the better understanding about the distance among the stars using various methods.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		H	M	H	H		L		M
CO2		H	L	H	H		L		H
CO3	H		M	L	M				M
CO4		M		H	L				M

H = Highly Related; M = Medium L = Low

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(Dr. Nishant Rana)

Dr Pravin Sadhu Chandan Joshi

(Dr. Chandan Joshi)

(Dr Abhishek Jha)

SEMESTER - IV

(DEPARTMENTAL ELECTIVES)

ANALOG CIRCUITS

CODE: BPH087A **Credits: 4**

Unit I

Two-Terminal Devices and their Applications: (1) Rectifier Diode. Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification. Efficiency. Qualitative idea of C, L and π - Filters. (2) Zener Diode and Voltage Regulation. (3) Photo Diode, (4) Tunnel Diode, (5) LED (6) Varactor Diode.

UNIT II

Transistors: NPN and PNP Transistors. Characteristics of CB, CE and CC Configurations. Current gains α, β and γ and Relations between them, Bias stability, Load Line Analysis of Transistors, DC Load line and Q-point, Mechanism of Current Flow. Active, Cutoff, and Saturation Regions. Transistor in Active Region and Equivalent Circuit.

UNIT-III

Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, design procedure for particular specifications, low frequency analysis of multistage amplifiers. Class A, B, and C Amplifiers.

Coupled Amplifiers: RC-Coupled Amplifier and its Frequency Response of Voltage Gain.

Unit IV

Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance and Gain, Stability, Distortion and Noise.

Operational Amplifiers: Review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications.

Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Unit V

Sinusoidal Oscillators: Barkhausen's Criterion for Self-sustained Oscillations. RC Phase Shift Oscillator, Determination of Frequency. Wein-Bridge Oscillator, Hartley Oscillator. Colpitts Oscillator

Digital-to-Analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog to digital converters (ADC): Single slope, dual slope, successive approximation, flash etc. Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Suggested Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
7. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
8. Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning
9. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.

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(Dr. Nishant Kaur)

Dr Pramod Saxena

(Dr. Chandan Joshi)

(Dr. Abhishek Shukla)

Course Outcomes: After completion this course, student shall be able to-

CO1: Develop a fundamental understanding of applications of PN junction diode for different type of rectifiers and voltage regulators

CO2: Demonstrate the working of NPN and PNP transistors in different biasing mode and equivalent circuits.

CO3: Acquire the knowledge of BJT circuits in designing amplifiers and coupled amplifiers

CO4: Learn the mechanism of feedback in amplifiers, and knowledge operational amplifiers with its different configurations.

CO5: Understand the operations of various sinusoidal oscillators and applications of operational amplifiers in D to A and A to D conversions.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	H	L	M			L		L
CO2	H	M	M	M	L			M	
CO3	H	M	H	M	L	M	L	L	
CO4	M	L	H	M	M				M
CO5	L	M	L	L	H	M	L		L

H=High; M=Medium; L=Low

ANALOG CIRCUITS LAB

CODE: BPH088A **Credit: 1**

Student has to perform any twelve experiments out of the followings:

1. Study the half wave rectification for positive and negative half cycle
2. Study the full wave rectification, centre tapped full wave rectification and Bridge full wave rectification
3. Study the operation of Half Wave rectifier and how Capacitor filter improves the performance
4. Study the operation of centre tapped rectifier and how Capacitor filter improves the performance
5. Study the operation of Bridge rectifier and how Capacitor filter improves the performance.
6. Study the characteristics of Zener diode and Zener diode as a voltage regulator
7. Study the Input and Output characteristics of BJT common base configuration
8. Study the Input and Output characteristics of BJT common emitter configuration
9. Study the characteristics of CE configuration of BJT as amplifier
10. Study the RC circuit as (i) voltage divider, (ii) low pass filter (iii) high pass filter
11. Study the operation of RC circuit as (i) differentiator and (ii) integrator
12. Study the basic properties of OP-AMP as (i) Inverting and (ii) Non-inverting Amplifier and gain
13. Study the operation of OP-AMP as (i) differentiator, and (ii) Integrator
14. To study RC phase shift oscillator using OP-AMP
15. To study the Wein-Bridge oscillator using OP-AMP
16. To construct and study the behavior of Colpitts oscillator and to measure its output frequency.
17. To design and construct a Hartley oscillator and to measure its output frequency.

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Dr. Pramod Sahni

Chandra Joshi (Dr Abhishek)

(Dr. Chandra Joshi)

18. To design a digital to analog converter (DAC) of given specifications
19. To study the analog to digital convertor (ADC) IC

Suggested Books:

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
3. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
4. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

Course Outcomes: After completion this course, student shall be able to-

CO1: Learn basic concepts of semiconductor diodes and their applications to rectifiers.
CO2: Learn about junction transistor and their applications.
CO3: Learn about different types of amplifiers including operational amplifier (Op-Amp) and their applications.
CO4: Learn about sinusoidal oscillators of various types and A/D conversion

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	H	M				M
CO2	H	M	M	H	M		L		M
CO3	H	M	L	M	L		L		L
CO4	H	M	M	L					L

H=High; M=Medium; L=Low

MECHANICS OF MATERIALS

Code: BPH089A **Credits:4**

UNIT I

Stresses and Strains: Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them.

UNIT II

Analysis of Stress and Strain: Introduction to three-dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear tress, Mohr circle for plane stress conditions.

Cylinders: Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lames equations.

UNIT III

Shear Force and Bending Moment: Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant / varying loads.

Stress in Beams: Bending and shear stress distribution in rectangular, I and T section beams.

UNIT IV

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory.

Torsion: Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin walled sections.

UNIT V

Columns: Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.

Strain Energy: Strain energy due to axial, shear, bending, torsion and impact load, Castigliano's theorem I and II and their applications.

Suggested Books:

1. Mechanics of Materials; J M Gere, B J Goodno, Cengage Eighth edition 2013
2. Fundamentals of Strength of Materials; P N Chandramouli PHI Learning Pvt. Ltd 2013
3. Strength of Materials; R K Rajput S. Chand and Company Pvt. Ltd 2014
4. Strength of Materials; S C Pilli and N Balasubramanya, Cengage 2019
5. Mechanics of Materials; Ferdinand Beer, Russell Johston, John Dewolf, David Mazurek McGraw Hill Education (India) Pvt. Ltd Latest edition
6. Mechanics of Materials; R C Hibbeler Pearson Latest edition

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand simple, compound, thermal stresses and strains their relations and strain energy.
CO2: Analyse structural members for stresses, strains and deformations.
CO3: Learn the structural members subjected to bending and shear loads.
CO4: Analyse shafts subjected to twisting loads.
CO5: Analyse the short columns for stability.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	M					
CO2	H		L	M					
CO3	H		M	L					
CO4	H		M	L					
CO5	H		L	L					

H = Highly Related; M = Medium L = Low

MECHANICS OF MATERIALS LAB

CODE: BPH090A **Credit: 1**

Requisites: Finite Element Analysis Software, MATLAB Software, Computers with necessary accessories

Student has to perform any twelve experiments out of the followings:

1. IZOD impact Test – To find the impact resistance of mild steel and cast iron.
2. CHARPY Impact Test - To find the impact resistance of mild steel and cast iron
3. Shear Force and Bending Moment diagrams for simply supported beams with point load

4. Shear Force and Bending Moment diagrams for simply supported beams with uniformly distributed load
5. Shear Force and Bending Moment diagrams for Cantilever supported beams with point load
6. Shear Force and Bending Moment diagrams for Cantilever supported beams with uniformly distributed load
7. Mohrs Circle
8. To find the angle of twist and to obtain some of the mechanical properties of the given material by conducting torsion test.
9. To develop an understanding of stress-strain curves of materials, and learn how to use them to determine various mechanical properties of ductile and brittle materials
10. To determine the compressive strength of given sample.
11. To determine the Column stability using boundary conditions.
12. Force and Stress analysis using link elements in Trusses, cables etc.
13. Stress and deflection analysis in beams with different support conditions.
14. Stress analysis of flat plates and simple shells.
15. Stress analysis of axi – symmetric components.
16. Thermal stress and heat transfer analysis of plates.
17. Thermal stress analysis of cylindrical shells.
18. Vibration analysis of spring-mass systems.
19. Model analysis of Beams.

Suggested Books:

1. The Mathworks, Inc, "The student Edition of Matlab", student Edition, The MATLAB curriculum series, 1997
2. Rudra Pratap, "Getting started with MATLAB", 1st Edition, Oxford University Press, 2010

Course Outcomes: After completion this course, student shall be able to-

CO1: Make use of software and analytical tools for various applications in the field of manufacturing the materials.

CO2: Acquire the knowledge in the area of testing of materials and components of structural elements experimentally

CO3: Learn the techniques and simulation modeling to understand the mechanics of materials under the forces applied.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M	H			H				M
CO2	H	M		L				L	
CO3	M	H		M	H				M

H = Highly Related; M = Medium L = Low

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STELLER STRUCTURE AND EVOLUTION

CODE: BPH091A **Credits: 4**

UNIT I

Basic Stellar properties: Stellar structure- description of stellar structure and evolution models, including star and planet formation, Stellar spectra, Stellar motions: Space velocity, proper motion, radial velocity, Local Standard of Rest, parallax.

UNIT II

Degenerate matter: concept of degenerate pressure, properties of white dwarfs, Chandrasekhar limit, neutron stars, pulsars, Synchrotron radiation, Schwarzschild radius, black holes, stellar remnants in binary systems.

UNIT III

Fundamental Equations: Basic properties of stars and observational methods, Stellar time scales. Equation of mass distribution and Equation of hydrostatic equilibrium. Virial Theorem. Equation of energy transport by radiative and convective processes. Equation of thermal equilibrium. Equation of state.

UNIT IV

Steller Models and Evolutions: Russell-Vogt theorem. Polytropic model. Lane-Emden equation and its solution. Properties of polytropes and applications. Jean's criterion for gravitational contraction, Star forming regions. Protostars, T-Tauri stars. Brown Dwarfs. Pre-Main Sequence Evolution: Pre-Main Sequence contraction under radiative and convective equilibrium.

UNIT V

Superdense Objects: White Dwarfs. Use of Polytropic model for completely degenerate stars. Chandrasekhar Mass. Mass-radius relation for White Dwarfs. Stability of White Dwarfs. Overview -Supernovae, Neutron stars, Black Holes.

Suggested Books:

1. An Introduction to Modern Astrophysics (Jul 2013), by Bradley W. Carroll and Dale A. Ostlie, ISBN-10: 1292022930, ISBN-13: 978-129202293
2. S. Chandrasekhar, An introduction to the Study of Stellar Structure, Dover.
3. M. Salaris & S. Cassisi, *Evolution of Stars and Stellar Populations*, 2005, John Wiley & Sons, ISBN 0-470-09220-3 (Salaris)
4. R. Kippenhahn & A. Weigert, *Stellar Structure and Evolution*, 1990, Springer-Verlag, ISBN 3-540-50211-4 (Kippenhahn; K&W).
5. D. Prialnik, *An Introduction to the Theory of Stellar Structure and Evolution*, 2nd edition, 2009, Cambridge University Press, ISBN 0-521-86604-9 (Prialnik)
6. C.J. Hansen, S.D. Kawaler & V. Trimble, *Stellar Interiors*, 2004, Springer-Verlag, ISBN 0-387-20089-4 (Hansen)
7. Weiss et al, Cox and Giuli's Principles of Stellar Evolution, Cambridge Scientific Publishers.
8. Shapiro and Tevkolsky: White Dwarfs, Neutron Stars and Black Holes

Course Outcomes: After completion this course, student shall be able to

CO1: Understand the global properties of steller- structure, spectra, motion and parallax.

CO2: Understand the degenerate properties of stars.

CO3: Derive the equations necessary to model the internal structure of stars.

CO4: Examine (qualitatively) the properties of simplified steller models to understand the evolutions of stars.

CO5: Understand (qualitatively) how stars of different masses evolve, and the endpoints of stellar evolution (white dwarfs, neutron stars etc.)

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MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M		H	M					L
CO2	L	M	M						
CO3	M	H		L					L
CO4	L		H	M					
CO5			M	M					M

H = Highly Related; M = Medium L = Low

HANDS ON PRACTICE LAB - II

CODE: BPH092A **Credits: 1**

Student has to perform the followings using Stellarium on computer-

1. To identify the retrograde motion of Planets with respect to the Background stars.
2. To extract the position of stars using declination, hour angle and the time readings provided by the Stellarium
3. To measure the Proper Motion of Barnard's Star
4. To identify a Circumpolar Star.
5. To measure astronomical distances using a type of stars called Cepheid variables.
6. To measure planetary distances.
7. To extract the orbital inclination of planet with respect to orbital plane of earth.
8. To determine the distance and age of cluster using Colour Magnitude Diagram.

Course Outcomes: After completion this course, shall be able to

CO1: Realize the motion or orientation of stars virtually through software.

CO2: Understand the motion of various types of stars.

CO3: Calculate the astronomical distances of stars.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	L	H		M	H				L
CO2		M	L	H	H				
CO3		M	L	H	H				L

H = Highly Related; M = Medium L = Low

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SEMESTER - V

(DEPARTMENTAL ELECTIVES)

ADVANCED MATERIALS

CODE: BPH093A **Credits: 4**

Unit I

Photonic Materials: Need for New Photonic Materials, composite materials for nonlinear optics, nanostructured waveguides for nonlinear optics quantum and nonlinear optics for advanced imaging applications.

Spintronic Materials: Modelling the growth of Mn on semiconductor substrates, Dilute magnetic semiconductor nanocrystals, Advances in wide bandgap materials for semiconductor spintronics

Unit II

Plasmonics: Metallic Nanoparticles and Nanorods, Metallic Nanoshells. Local Field Enhancement, Subwavelength Aperture Plasmonics, Plasmonic Wave Guiding. Applications of Metallic Nanostructures. Radiative Decay Engineering

Unit III

Smart Materials and Systems: Thermoresponsive materials, piezoelectric materials, electrostrictive and magnetostrictive materials, Magnetic materials, superparamagntism in metallic nanoparticles, Giant and colossal magnetic materials, ferrofluids, ER and MR fluids, biomimetic materials, smart gel, shape memory alloys and polymers.

Unit IV

Advanced Materials: Bimetallic Catalysts, Graphite Intercalation Compounds as catalysts, Carbides, Nitrides, and Borides for Catalysis, Complex Catalysts on Inorganic Supports. Zeolite Structures as Drug Delivery Systems and Biomedical applications.

Unit V

Nanomaterials: Amorphous, Crystalline, microcrystalline, quasicrystalline and nanocrystalline materials- historical development of nanomaterials, Nanomaterials classification (Gleiter's Classification) properly changes done to size effects, Hall – petch, inverse Hall- petch effects, polymeric nanostructures

Zero and 1Dimensional Nanomaterials: Nanoparticles – Properties – Processing – Liquid state processing - Sol-gel process, wet chemical synthesis – Vapour state processing – PVD, CVD, Aerosol processing, solid state processing, Application of nanoparticles. Carbon nanotubes: Structure of CNT and classification – Processing – Solid carbon based production techniques.

Suggested Books

1. Solid State Physics, A. J. Dekkar, Prentice Hall Inc.
2. Elementary Solid State Physics: Principles and applications, M. A. Omar, Addison-Wesley.
3. Advanced Materials in Catalysis, Frank Bolz, Academic Press, 1977
4. Advanced Healthcare Materials Tiwari, A. (ed) (2014), John Wiley & Sons, Inc., Hoboken, NJ, USA.
5. Charles P. Poole Jr., Frank J. Ownes, 'Introduction to Nanotechnology", Wiley Interscience, 2003.
6. G Timp (ed), "Nanotechnology", AIP press/Springer, 1999.
7. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.
8. G. Wilde, "Nanostructured Materials', Elsevier, 2008.

Course Outcomes: After completion this course, student shall be able to-

CO1: Understand the crystal structure and characterization of various nanomaterials

CO2: Evaluate the characteristic crystal structure and their influence on properties of the materials.

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(Dr. Nishant Kaur)

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CO3: Demonstrate their knowledge in advanced material science which helps in applications of various materials in industry and to society.
CO4: Able to understand and describe the development of nanomaterials and its classification
CO5: Able to understand the synthesis routes of zero and one dimensional nanomaterials.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M	H	L	H				L	
CO2	H	L		M	M			M	
CO3	L	M	M	M	L	L	H	H	M
CO4	H	M	L	M		M	M	H	H
CO5	H	M	L	M	M	L	M	H	H

H = Highly Related; M = Medium L = Low

ADVANCED MATERIALS - SEMINAR

CODE: BPH094A **Credit: 1**

Method of Evaluation:
During the seminar session each student is expected to prepare and present a topic on advance materials or latest ongoing research on smart materials, for duration of about 15 minutes. Each student is expected to present at least twice during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report.

Course Outcomes: After this course student shall be able-
CO1: To use various teaching aids such as projectors, power point presentation and demonstrative models
CO2: To review, prepare and present scientific article or a review articles or a publishable research articles
CO3: Develop their analyzing skill, learn the skill to work in team, helps them to face the placement interviews.
CO4: Prepare themselves for their appropriate role in contributing towards the welfare of Society and hence in national development.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		H			H				
CO2	H		M	H		L	H		M
CO3	L	M		M		H	M		L
CO4			L					H	

H = Highly Related; M = Medium L = Low

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(Dr. Nishant Kaur)
Dr. Chandan Joshi

OPTOELECTRONICS

CODE: BPH095A **Credits: 4**

Unit I

Optical processes in semiconductors – electron hole recombination, absorption, Franz-Keldysh effect, Stark effect, quantum confined Stark effect, deep level transitions, Auger recombination heat generation and dissipation, heat sources.

Unit II

Electron–photon processes - Carrier radiative recombination and light-emitting-devices (LED) Stimulated processes, lasing mechanism, and modes.

Photon–electron processes - Photoconductivity and detectors Imaging sensors Photovoltaic effect and solar cells.

Photon–photon processes - Electromagnetic wave propagation, waveguide, and fiber optics Light polarization and modulation Optical systems for communication Photonic lattice and other low-dimensional materials for optoelectronic applications

Unit III

Display Devices and Lasers - Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Injection Luminescence, LED Display, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Classes of Lasers, Mode Locking, laser applications.

Unit IV

Optical Detection Devices - Photo detector, Thermal detector, Photo Devices, Photo Conductors, Photo diodes, Detector Performance.

Optoelectronic Modulator - Introduction, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acoustoptic devices, Optical, Switching and Logic Devices.

Unit V

Introduction to optical components - Directional couplers, multiplexers, attenuators, isolators, circulators, tunable filters, fixed filters, add drop multiplexers, optical cross connects, wavelength convertors, optical bistable devices.

Optoelectronic Integrated Circuits - Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.

Suggested Books:

1. Pallab Bhattacharya: Semiconductor Optoelectronic Devices, Pearson, 2009
2. Yariv, Photonics Optical Electronics in modern communication, 6/e ,Oxford Univ Press,2006.
3. J. Wilson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall of India Pvt. Ltd., New Delhi, 1995.
4. Jasprit Singh, "Opto Electronics – As Introduction to materials and devices", McGraw-Hill International Edition, 1998.
5. Alastair Buckley, Organic Light-Emitting Diodes, Woodhead, 2013.
6. Bandyopadhay, Optical communicatoion and networks, PHI, 2014.
7. Piprek, Semiconductor Optoelectronic Devices, Elsevier, 2008.
8. Xun Li, Optoelectronic Devices Design Modelling and Simulation, Cambridge University Press, 2009.

Course Outcomes: After completion this course, student shall be able to-

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(Dr. Chandan Joshi)

CO1: Understand basic laws and phenomena of optical process in semiconductors.
CO2: Describe the fundamental physical processes of optoelectronic transitions and apply the concepts to different optoelectronic devices.
CO3: Define, in depth, the principles/functionality of the most important optoelectronic display devices, compare and evaluate the different device designs.
CO4: Understand the basics of optical detection and also able to learn working of different optical detection devices.
CO5: Demonstrate an understanding of the basic design requirements for optoelectronic integration and identify different material.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L							
CO2	M			H	M			M	
CO3	M		M						
CO4	L	M			H			L	
CO5	L	H	L						L

H=High; M=Medium; L=Low

OPTOELECTRONICS LAB

CODE: BPH096A **Credit: 1**

Student has to perform the following experiments-

1. LED current-voltage characteristics.
2. Photodiode responsivity characterization.
3. Laser diode DC characteristics.
4. Pulsed (AC) measurements using LEDs, laser diodes, and photodiodes.
5. Measurement of beam characteristics of lasers.
6. Characteristics of opto-coupler.
7. Measurement of losses- attenuation, bending in optical fibers.
8. Measurement of numerical aperture.
9. Study of dispersion in optical fibers.
10. Design and analysis of different types of optical fibers using OPTIFIBER

Suggested Books:

1. Optoelectronics: Introductory Theory & Experiments by Gary Cardinale, Cengage Learning.
2. FIBER OPTICS THROUGH EXPERIMENTS, M.R. Shenoy, S. Khijawania, A.K. Ghatak, and B. P. PAL, Viva Books Publishers.
3. Optoelectronic Devices Design Modelling and Simulation by Xun Li, Cambridge University Press, 2009.
4. Optics Experiments and Demonstrations for Student Laboratories by Stephen G Lipson, IOP Publishing.

Course Outcomes: After completion this course, student shall be able to-
CO1: Gain the hands on experience to understand the optical devices LED and photodiode.
CO2: Learn the functioning of different optical diodes.

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CO3: Understand the basics of light propagation and different mechanism in different types of optical fibres.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	L	H		L	H				
CO2		M	H			M			M
CO3	M	M		M				L	

H=High; M=Medium; L=Low

PHYSICS OF THE SUN

CODE: BPH097A **Credits: 4**

UNIT I

Around the Sun: Overall structure, Chemistry of the Sun, solar observations, solar disc and sunspots, solar atmosphere, Oscillations, Convection, rotation, magnetism, solar cycle chromosphere, corona, solar wind, quiet Sun, Active Sun, Helioseismology.

UNIT II

Solar Terrestrial: Interactions of solar radiation with Earth: plasma physics, solar wind, Earth's magnetic field. Ionospheric physics. Terrestrial physics: Earth's energy balance, Atmosphere. Environmental effects.

UNIT III

Solar Magnetism: Elements of dynamo theory & Solar kinematic dynamos, Concentrating and expelling the magnetic field, Lorentz force restriction on dynamo action, Basic physics of magnetic flux tubes, Surface magnetic field & Basic large-scale magnetic field, Parker's spiral & Basic heliospheric current sheet, Observed large-scale structure

UNIT IV

The Ionosphere: Solar radiation and production of ionization, Ionization Profile, Ion Composition and Chemistry, The D-, The E-, The F Region, Gyration-Dominated Plasma Transport, Ambipolar Electric Field and Diffusion, Diffusive Equilibrium in the F2 Region.

UNIT V

The Solar Magnetosphere: Interaction of the Solar Wind with the Terrestrial Magnetic Field, The Bow Shock and the Magnetopause, The Magnetospheric Cavity, Magnetospheric Current Systems, The Ring Current, Field-Aligned Currents, Plasma Convection in the Magnetosphere, The Axford-Hines and the Dungey Models, Magnetic Diffusion & Magnetic Reconnection, Convection Electric Field & High-Latitude Electrodynamics.

Suggested Books:

1. Physics of the Sun: A First Course; Mullan, Dermott J. 2010
2. Fundamentals of Solar Astronomy by Arvind Bhatnagar and William Livingston, latest edition, World Scientific
3. J. K. Hargreaves, The Solar Terrestrial Environment, Cambridge Atmospheric and space science series
4. Kellenrode, M-B, Space Physics, An Introduction to Plasmas and Particles in the Heliosphere and Magnetospheres, Springer, 2000

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(Dr. Nishant Sarin)

Dr Pawan Sekhra

(Dr. Chandan Joshi)

(Dr. Abhishek Lahiri)

5. Walker, A. D. M., Magnetohydrodynamic Waves in Space, Institute of Physics Publishing,2005.
6. Solar and stellar magnetic activity by C. J. Schrijver and C. Zwaan, Cambridge University press

Course Outcomes: After completion this course, student shall be able to
CO1: Acquire the knowledge and understanding of physical properties and parameters of Sun.
CO2: Understand the basic knowledge about the physics of Solar and terrestrial environment.
CO3: Apply basic electromagnetism to derive the kinetic theory of plasmas.
CO4: Explain Sun's interior structure, physics of solar wind and origin of cosmic rays.
CO5: Explain the main consequences of magnetic reconnection for Earth's magnetosphere.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		M						H
CO2	M		L	H					M
CO3	H	M		L					
CO4		M		H					L
CO5	M		M	H				L	M

H = Highly Related; M = Medium L = Low

PHYSICS OF THE SUN - SEMINAR

CODE: BPH098A **Credits: 1**

Method of Evaluation:
During the seminar session each student is expected to prepare a physics report on the recent exploration and developments in research about the Sun duration of about 20 minutes. Each student is expected to present at least twice during the semester and the student will be evaluated on the basis of contents and methodology of exploration. At the end of the semester, he/she will have to submit a conclusive report on his/her topic with seminar presentation and marks will be given based on cumulative assessment. A Faculty guide is to be allotted and he/she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

Course Outcome: After completion this course, student shall be able to
CO1: Review, prepare and present a substantial report.
CO2: Demonstrate and interpret the physics and ongoing recent developments in solar physics.
CO3: Learn to maintain the sanctity of referring the information like texts, related research-based outcomes by others globally.
CO4: Develop the management skill to accomplish the project/task and produce his/her own critics and thoughts as results to be work upon.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course	Program Outcomes (POs)

Outcomes	I	II	III	IV	V	VI	VII	VIII	IX
CO1			H	H	L		M		L
CO2		H	M	M	H	L			M
CO3				L		M	H		
CO4			M		M		H	L	L

H = Highly Related; M = Medium L = Low

ELECTROMAGNETIC THEORY

CODE: BPH099A **CREDIT: 4**

UNIT-I

Maxwell Equations: Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.

UNIT-II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media.

UNIT-III

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection.

UNIT-IV

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction.

UNIT-V

Wave Guides: Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.

Optical Fibres:- Introduction, Numerical Aperture, acceptance angle, fractional index, Step and Graded Indices (Definitions Only), Single and Multiple Mode Fibres (Concept and Definition Only) and its uses.

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
7. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

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Course Outcomes: After completion this course, student shall be able to-

CO1: Learn the role of Maxwell's equations in unifying electricity and magnetism, and able to deduce its properties.

CO2: To analyze the phenomena of wave propagation in the unbounded, bounded, vacuum, dielectric, guided and unguided media.

CO3: Understand the laws of reflection and refraction and to calculate the reflection and transmission coefficients at plane interface in bounded media.

CO4: Understand the linear, circular and elliptical polarizations of EM waves, propagation of EM waves in anisotropic media, uniaxial and biaxial crystals

CO5: Understand the features of planar optical wave guide, phase and group velocities, and propagation of EM waves through optical fibres.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAMOUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H			L					M
CO2	M	L	M	L				L	
CO3	M	M	L	M					
CO4	H	M	L	M					L
CO5	H	L	M	M				M	

H = Highly Related; M = Medium L = Low

ELECTROMAGNETIC LAB

CODE: BPH100A **Credit: 1**

Student has to perform any ten experiments out of the followings:

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air glass interface.
11. To verify the Stefan's law of radiation and to determine Stefan's constant.
12. To determine the Boltzmann constant using V-I characteristics of PN junction diode

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Dr. Nishant Saxena

Dr. Chandan Joshi

Suggested Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Course Outcomes: After completion this course, students shall be able to-

CO1: Test and verify the properties of light by polarizations using Polarimeter and Babinet compensator.

CO2: Demonstrate the variation in velocities and wavelength of ultrasonic waves in different medium.

CO3: Learn the properties of glass and liquid materials by measuring the refractive index.

CO4: Understand the behaviour of radiation with temperature and evaluation of Boltzmann constant.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M		L		L			
CO2	H		M	M	L			L	
CO3	M	L	L	H				L	
CO4	H		M	M		L			

H = Highly Related; M = Medium L = Low

COMMUNICATION SYSTEMS

CODE: BPH101A **Credits: 4**

Unit I

Introduction to Communication Systems: Elements of a communication system–transmitter and receiver; Signal types in communication; FDM and TDM; Processing of signals for transmission – basic concepts of amplitude and frequency modulation; Examples of telecommunication systems – telephone, radio, television, mobile communication and satellite communication.

Unit II

Analog Modulation: Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver

Unit III

Analog Pulse Modulation: Channel capacity, Sampling theorem, Basic Principles-PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing

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Dr. Pramod Sexena

Chandan Joshi

(Dr. Chandan Joshi)

Digital Pulse Modulation: Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).

Unit IV

Elements of Radio Receiver and Transmitter: Super heterodyne receivers and their characteristics; Different receiver architectures; RF and IF amplifiers, mixers.

Basic concept of Television System: Image characteristics; Interlaced scanning, horizontal and vertical resolution, video bandwidth; Luminance and chrominance signals, composite video signal; Digital TV and video compression; TV camera; Transceiver architecture for TV.

Unit V

Satellite Communication System: Introduction to satellite systems; Orbital period and velocity; Coverage angle and slant range; Satellite link design; Multiple access techniques used in satellite systems.

Mobile Telephony System – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, Qualitative only - block diagram of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, block diagram of mobile phone handset, 2G, 3G and 4G concepts.

Suggested Books:

1. Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
2. Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
3. Electronic Communication systems, G. Kennedy, 3rd Edn., 1999, Tata McGraw Hill.
4. Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
5. Communication Systems, S. Haykin, 2006, Wiley India
6. Electronic Communication system, Blake, Cengage, 5th edition.
7. Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press

Course Outcomes: After completion this course, student shall be able to-

CO1: Understand the various signals used in communication with frequency modulation.

CO2: Demonstrate the knowledge of different types of modulation techniques.

CO3: Learn the concepts of sampling, multiplexing and digital transmission via encoding and decoding

CO4: Understand the working of receiver and transmitter in radio and television communication.

CO5: Acquire the knowledge of satellite communications and mobile communications.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M	H	L						
CO2	H	M		L	L				M
CO3	M								
CO4	L	M	M	H	M				L
CO5	M	H	L	M	M				L

H=High; M=Medium; L=Low

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Dr. Pranav Saxena

(Dr. Chandan Joshi)

COMMUNICATION SYSTEMS LAB

CODE: BPH102A **Credit:1**

Student has to perform the following experiments-

1. To design an Amplitude Modulator using Transistor
2. To study envelope detector for demodulation of AM signal
3. To study FM - Generator and Detector circuit
4. To study AM Transmitter and Receiver
5. To study FM Transmitter and Receiver
6. To study Time Division Multiplexing (TDM)
7. To study Pulse Amplitude Modulation (PAM)
8. To study Pulse Width Modulation (PWM)
9. To study Pulse Position Modulation (PPM)
10. To study ASK, PSK and FSK modulators

Suggested Books:

1. Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
2. Electronic Communication system, Blake, Cengage, 5th edition.

Course Outcomes: After completion this course, student shall be able to-

CO1: Gain the hands on experience to understand the modulation and demodulation circuits.
CO2: Learn the functioning of transmitters and receivers for AM and FM
CO3: Understand the basics of communication mechanism in satellite and mobile telephony systems.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	L	H	M		M				
CO2		H	M	L					
CO3	M	H	L	M	L				L

H=High; M=Medium; L=Low

COMPOSITE MATERIALS

CODE: BPH103A **Credits: 4**

UNIT I

Introduction to Nanocomposites Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites. Advantage of composite materials, mechanical properties, Thermal, electrical and electronic and optical properties. Super hard nanocomposites-designing and mechanical properties - stress-strain relationship, toughness, strength, and plasticity.

UNIT II

Ceramic Nanocompsites Ceramic based nanoporous composites, metal matrix nanocomposites, natural nano-bioccomposites, bio-mimetic nanocompostes and biologically inspired nanocomposites, nanocompsites for hard coatings, DLC coatings, thin film naocomposites, modelling of nanocomposites, synthesis of various nanocomposites materials, sputtering, mechanical alloying.

UNIT III

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(Dr. Nishant Kaw)

Dr Pramod Sekhe

Chandan Joshi

(Dr. Chandan Joshi)

Dr Abhishek Sharma

Polymer Nanocomposites Introduction to polymer composites, Processing of nanoparticles, binding mechanisms in nanoparticles, dispersion of nanoparticles, and stabilization of nanoparticles. Processing and fabrication of polymer nanocomposites, Melt blending, solvent casting, In-situ polymerization, solution polymerization, template synthesis, high shear mixing. Homogeneous/heterogeneous nucleation, plasma promoted nucleation.

UNIT IV

Natural Nanocomposites: Spider silk, bones, shells; organic–inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposite material; use of synthetic nanocomposites for bone teeth replacement. Bioactive nanocomposites in bone grafting and tissue engineering, inorganic/polymer nanocomposites for dental restoration and bone replacement applications.

UNIT V

Bio ceramics for implant coating Calcium phosphates-hydroxyapatites Ti6Al4V and other biomedical alloys, implant tissue interfacing-metal organic CVD-use of tricalcium phosphate-biomimetic and solution based processing- osteoporosis- osteo plastic, regeneration of bones by using bio compatible ceramics, bio interactive hydro gels- PEG coating and surface modifications, PEG hydrogels patterned on surfaces- PEG based hydrogels.

Suggested Books:

1. Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 1989
2. Sharma, S.C., "Composite materials", Narosa Publications, 2000.
3. Chawla K. K., "Composite materials", Second Edition, Springer – Verlag, 1998
4. P.M. Ajayan, L.S. Schadler and P.V. Braun, "Nanocomposite Science and Technology" WileyVCH GmbH Co. 2003.
5. Ed A.D. Pomogailo and V.N.Kestelman, "Metalopolymer Nanocomposites", Springer-Verlag, 2005. 4.
6. Kenneth E.Gonsalves, Craig R. Halberstadt, Cato T. Laurencin, Lakshmi S. Nair, "Biomedical nanostructures" John-Wiley & Sons, 2008.
7. Steven S Saliterman, Fundamentals of Bio-MEMS and Medical Microdevices, 2006

Course Outcomes: After completion this course, students shall be able to-

CO1: Learn the basic concept and classification of composite materials with their properties.
CO2: Acquire the knowledge in various ceramics metal composites and its processing methods.
CO3: Learn the knowledge in polymer based composites and its processing methods.
CO4: Demonstrate the knowledge of Natural and Bio composite materials and its importance to society.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M			L					
CO2	H	M							
CO3	H	L		M					
CO4	M			M				M	L

H = Highly Related; M = Medium L = Low

Prof Y.K Vijay

(Dr. Nishant Tiwari)

Dr Pranav Seerwa

Chandan Joshi

(Dr. Chandan Joshi)

(Dr. Abhishek Sharma)

COMPOSITE MATERIALS LAB

CODE: BPH104A **Credit:1**

Student has to perform the following experiments through demonstrations-

1. Preparation of Continuous Fiber reinforced Polymer Composites
2. Preparation of Dis-Continuous Fiber reinforced Polymer Composites
3. Study of Tensile strength and young's modulus of FRP composites
4. Study of Flexural strength of FRP composites
5. Study of Hardness of FRP composites
6. Study of drop weight impact testing
7. Preparation of Al-SiC composites by stir casting method
8. Study of microstructure, hardness and density of Al-SiC composite
9. Study of Tensile strength of Al-SiC composites
10. Environmental Testing (Humidity and temperature)

Course Outcomes: After completion this course, student shall be able to-

CO1: Learn the fabrication processes of different composite materials and the mechanical characterization of these materials.

CO2: Acquire the knowledge of preparing the composite materials.

CO3: Demonstrate the structural properties of composite materials.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		M	M					
CO2	M	H	L	M					L
CO3	M	H	L						L

H = Highly Related; M = Medium L = Low

GALAXIES AND UNIVERSE

CODE: BPH105A **Credits: 4**

UNIT I

The Milky Way: Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Stars and Star Clusters of the Milky Way, Properties of and around the Galactic Nucleus.

UNIT II

Classification of Galaxies: Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies (The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and Lenticular Galaxies (Bulges, Disks, Galactic Halo) The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms, Active Galaxies.

UNIT III

Principles of Relativity: Overview of Special Relativity-Space time interval and Lorentz metric four vectors, Introduction to general relativity (GR) - equivalence principle - notions of curvature - gravitation as a manifestation of the curvature of space time. Curved surfaces. Schwarzschild solution; Gravitational red shift, the bending of light and gravitational lensing.

UNIT IV

Cosmology Models: Universe at large scales, homogeneity and isotropy, distance ladder, Newtonian cosmology, expansion and redshift, Cosmological Principle, Hubble's law, Robertson-Walker metric, Observable quantities, luminosity and angular diameter distances, Horizon distance, Overview of Friedman- Robertson-Walker models.

UNIT V

Early Universe: Thermal History of the Universe, distribution functions in the early Universe, relativistic and nonrelativistic limits, Decoupling of neutrinos and the relic neutrino background, Nucleosynthesis, Decoupling of matter and radiation, Overview -Cosmic microwave background radiation (CMB)-Formation of galaxies and large scale structures, Idea of Accelerating universe and type-Ia supernovae.

Suggested Books:

1. Carroll & Ostlie, Modern Astrophysics, Addison Wesley Background reading:
2. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing
3. The physical universe: An introduction to astronomy, F.Shu, Mill Valley: University Science Books
4. K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New Age International (p) Ltd, New Delhi,2002
5. L.S. Sparke and J.S. Gallagher, Galaxies in the Universe, Cambridge University Press
6. J. Binney and M. Merrifield, Galactic Astronomy, Princeton University Press.
7. A.K. Kembhavi and J.V. Narlikar, Quasars and Active Galactic Nuclei: An Introduction, Cambridge University Press

Course Outcomes: After completion this course, student shall be able to

CO1: Acquire the basic knowledge of Milky way, structure and properties of Galactic nucleus.

CO2: Classify the various Galaxies and understand them by their properties.

CO3: Understand the importance of general theory of relativity in understanding the curved spaces and gravitational red shift.

CO4: Learn the structure of Universe using various cosmological models.

CO5: Acquire the understanding of the evolution of universe, nucleosynthesis and formation of galaxies.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Cours Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	M					M
CO2	M			H					M
CO3		M		M	L				L
CO4	H			L					
CO5	H		M	H					M

H = Highly Related; M = Medium L = Low

Prof. Y.K. Vijay

(Dr. Nishant Lawu)
Dr Pramav Sarma

(Dr. Chandan Joshi)

(Dr. Abhishek Sharma)

GALAXIES AND UNIVERSE - SEMINAR

CODE: BPH106A **Credit: 1**

Method of Evaluation:
During the seminar session each student is expected to prepare a report on the recent exploration and developments in research about the Galaxies and Universe for duration of about 20 minutes. Each student is expected to present at least twice during the semester and the student will be evaluated on the basis of contents and methodology of exploration. At the end of the semester, he / she will have to submit a conclusive report on his / her topic with seminar presentation and marks will be given based on cumulative assessment. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal

Course Outcome: After completion this course, student shall be able to

CO1: Review, prepare and present technical reports on various models and understandings of the Universe and Galaxies.

CO2: Demonstrate and interpret the physics and ongoing recent developments.

CO3: Learn to maintain the sanctity of referring the information like texts, related research-based outcomes by others globally.

CO4: Develop the management skill to accomplish the project/task and produce his/her own critics and thoughts as results to be work upon.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1			H		L		M		L
CO2		H	M	L	H	L			M
CO3				M		M	H		
CO4			M		M		H	L	L

H = Highly Related; M = Medium L = Low

Dr Kumar Laxma

Prof. V.K. Vijay

Nlaxe
(Dr. Nishant Laxe)

(Dr. Abhishek Joshi)

Chandan Joshi
(Dr. Chandan Joshi)

SEMESTER - VI

(DEPARTMENTAL ELECTIVES)

FUNDAMENTALS OF PLASMA PHYSICS

CODE: BPH107A **Credit: 4**

Unit-I

Plasma State: Ionized gas, Saha's ionization equation; Collective degrees of freedom, Definition of Plasma, Concept of Plasma temperature, Debye shielding, Quasi-neutrality, Plasma parameters, Plasma approximation, Natural existence of Plasma.

Unit-II

Single-particle motion: Dynamics of charged particles in electro-magnetic fields, Particle drifts, EXB drifts, Grad-B drift, Curvature drift, Polarization drift, Adiabatic invariants and their technological applications.

Unit-III

Kinetic theory of Plasma: Vlasov equations, Solution of linearized Vlasov equation, Langmuir waves, Ion-sound waves, Wave-particle interaction and Landau damping.

Fluid theory of Plasma: Plasma oscillations, Electron-acoustic waves, Ion-acoustic waves Electrostatic ion-waves perpendicular to magnetic field, Electromagnetic waves perpendicular to magnetic field.

Unit-IV

Basic principles of gas discharge physics: Electrical breakdown, Generation of thermal and nonthermal plasma, DC and RF (radiofrequency) discharges, Microwave discharge, Dielectric barrier discharge.

Unit-V

Plasma diagnostic methods: Electric probes (Langmuir and emissive probe), Electric probe characteristics and measurement of plasma parameters (plasma potential, electron & ion density, electron temperature etc.), Magnetic probes, Mass and optical spectroscopy.

Application of Plasma Physics: Thermonuclear fusion- present status and problems, Requirements for fusion plasmas- confinement, beta, power and particle exhaust.

Suggested Books:

1. Bittencourt, J. A., Fundamentals of Plasma Physics (Springer, New York, 2004).
2. Bellan, P. M., Fundamentals of Plasma Physics (Cambridge, UK, 2006)
3. Cap, F. F, Handbook on Plasma Instabilities (Academic Press, New York, 1976).
4. Nicholson, D. R., Introduction to Plasma Theory (John Wiley & Sons, New York, 1983)
5. Chen, F. F., Introduction to Plasma Physics and Controlled Fusion, 2nd edition, (Plenum, New York, 1984)
6. Hutchinson, I. H., Principles of Plasma Diagnostics, 2nd edition, (Cambridge University Press,(2002)
7. Lieberman, M. A. and Lichtenberg, A. J., Principles of Plasma Discharges and Materials Processing (John Wiley, New York, 1994)

Course Outcomes: After completing this course, student shall be able to

CO1: Interpret the basics of the plasma parameters and related fluid equations

CO2: Understand and use the basic mathematical formalism needed for describing the dynamics of continuous media

CO3: Describe the kinetic behavior and propagation of waves in plasmas using fluid theory.

CO4: Acquire the knowledge of various discharging processes for generating plasmas.

CO5: Understand the various plasma diagnostic mechanism and applications.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M	L						
CO2	L	H	M		M				
CO3	M	L	L	H					L
CO4	H	M		L				M	
CO5	L	M	L	H	L			M	L

H = Highly Related; M = Medium L = Low

FUNDAMENTALS OF PLASMA PHYSICS - SEMINAR

CODE: BPH108A **Credit: 1**

Method of Evaluation:
During the seminar session each student is expected to prepare and present any topic prescribed in syllabus for duration of about 15 minutes. Each student is expected to present at least twice during the semester and the student is evaluated based on that. At the end of the semester, he / she has to submit a report on his / her topic of seminar and presentation, the marks are given on the basis of complete evaluation.

Course Outcomes: After this course student shall be able-

CO1: To use various teaching aids such as projectors, power point presentation, advanced excel and demonstrative models.

CO2: Acquire the skill/knowledge to review the literatures, research articles and latest updates, to resolve the queries and prepare a report with merits and demerits.

CO3: Develop the ability to identify the relevant E-resources, statistical data/information, and skill to manage the project in time constrained.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		M		L	H				
CO2		L	M	H	M	M	M		M
CO3		M	L	H	M	H	M		M

H = Highly Related; M = Medium L = Low.

ELECTRONIC INSTRUMENTATION

CODE: BPH109A **Credits: 4**

Unit I

Measurement of Errors - Accuracy & precision, Repeatability, Limits of errors, Systematic & random errors, Modeling of errors, Probable error & standard deviation, Gaussian error analysis, Combination of errors.

Unit II

Electronic Instruments: Electronic Voltmeter, Electronic Multimeters, Digital Voltmeter, Digital Frequency Meter, Circuit For Measurement of Frequency, Simplified Composite Circuit For Digital Frequency Meter High Frequency Measurements Period Measurement, Ratio And Multiple Ratio Measurements and Digital LCR meter and Q meter, Vector Impedance meter, RF Power & Voltage Measurements, Introduction to shielding & grounding.

Unit III

Oscilloscopes: Basic CRO circuits, CRO Probes, Techniques of Measurement of frequency, Phase Angle and Time Delay, Multibeam, multi trace, Digital storage oscilloscope.

Display Devices: Digital Display Methods, Digital Display Units, Segmental Displays Dot Matrices, Rear Projection Display, Light Emitting Diode, Liquid Crystal Diodes, Segmental Gas Discharge Displays, Decade Counting Assembly's, Display Systems, Decimal Decoders, BCD To 7-Segment Converter, BCD To Dot Matrix Converter, Sensitivity Of Digital Meters, Accuracy Specification of Digital Multi meters

Unit IV

Signal Generation And Signal Analysis: Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators. Signal Analysis - Measurement Technique, Wave Analyzers, and Frequency - selective wave analyser, Heterodyne wave analyser, Harmonic distortion analyser, and Spectrum analyser.

Unit V

Transducers: Classification, Selection Criteria, Characteristics, Construction, Working Principles and Application of following Transducers:- RTD, Thermocouples, Thermistors, LVDT, Strain Gauges, Bourdon Tubes, Seismic Accelerometers, Tachogenerators, Load Cell, Piezoelectric Transducers, Ultrasonic Flow Meters.

Suggested Books:

1. A.D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques" 5th ed., PHI, 2002
2. A.K. Sawhany, "Electrical and Electronics Measurements & Instrumentation", Dhanpath Roy & Co, 2005
3. David A. Bell, "Electronic Instrumentation & Measurements", 2nd ed., PHI, 2003.
4. K. Lal Kishore, "Electronic Measurements & Instrumentations", Pearson edition, 2005
5. Robert A.Witte, "Electronic Test Instruments, Analog and Digital Measurements", 2nd ed., Pearsoned., 2004.
6. Rajput R.K., Electrical and Electronics Measurements and Instrumentation; S Chand & Company.

Course Outcomes: After completion this course, student shall be able to-

CO1: Acquire the knowledge in-depth with the understanding of measurement of errors.

CO2: Learn the operation of basic electronic instruments.

CO3: Aware about the functioning and mechanism of various display devices.

CO4: Understand the different terminologies related to signal generators and wave analyzers.

CO5: Understand the principles and importance of various transducers.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H								
CO2		H		H	M				L

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Dr. Abhishek Sharma

CO3	L	M	M	H	L				L
CO4	L	M	M						
CO5		L		M					

H=High; M=Medium; L=Low

ELECTRONIC INSTRUMENTATION LAB

CODE: BPH110A **Credit: 1**

Students has to perform the following experiments-

1. Measurement of LCRQ meter.
2. Study and calibration of LVDT transducer and measurement of displacement.
3. Measurement of distance using LDR
4. Measurements of temperature using Resistance Temperature Detector (RTD).
5. Measurements of temperature using Thermocouple.
6. Measurements of distance using inductive transducer.
7. To study the basic functions (front panel controls) of oscilloscope.
8. To Study the Phase Shift on CRO Using LVDT.
9. To study and verify characteristic of variable resistor transducer.
10. Measurement of Intensity of Light using LDR Transducer.
11. To Plot and Studying the Characteristics of Thermocouple.
12. To Plot and Studying the Graph between Temperature and Resistance using RTD.
13. Fourier series analysis of a square wave using spectrum analyzer.
14. To generate various signals using arbitrary waveform generator.
15. To demonstrate the functionality of function generator and its use as a test and Measurement equipment.

Suggested Books:

1. A.D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques" 5th ed., PHI, 2002
2. A.K. Sawhany, "Electrical and Electronics Measurements & Instrumentation", Dhanpath Roy & Co, 2005
3. K. Lal Kishore, "Electronic Measurements & Instrumentations", Pearson edition, 2005
4. C. Nakra, K.K. Choudhary,—Instrumentation, Measurement & Analysis, Tata McGraw Hill, 1st Edition,2013.

Course Outcomes: After completion this course, student shall be able to-

CO1: Learn the performance and calibration of electronic instruments as well.

CO2: Understand the working and measurement techniques of transducers.

CO3: Understand the principles of signals generators and analyze the waveform.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M		L					M
CO2	L	H	M	M	M				L

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Dr. Kumar Sourav Alam

(Dr. Nishant Kumar Chandan Joshi)

(Dr. Abhishek Shr

CO3	M	H	M	L	M				L

H=High; M=Medium; L=Low

COMPUTATIONAL MATERIAL SCIENCE

CODE: BPH111A **Credits: 4**

UNIT I

Introduction A Brief History of the Finite Element Method - Basic Steps in the Finite Element Method- Theory vs Computer Applications of FEA. Matrices - basic matrix problems, Simultaneous linear algebraic equations –Basic problems. Nodes-Elements-Types of Elements- Element Characteristics

UNIT II

One Dimensional Problem: Discretization – Local and global Numbering- Approximate functions- Coordinate systems-Shape Functions – Two node Linear: bar and link element. Trusses & Beams– Finite element formulation - Solid Mechanics problems on Bar ,Shaft, Stepped Shaft , Tapper shaft and Trusses – Heat Transfer Problems on Fin and Composite Wall.

UNIT III

Dimensional Problems: Introduction- Plane Stress – Plane Strain - Triangular Elements - Coordinate System – Shape; Function -Finite Element Formulation – Rectangular Elements -Coordinate System – Shape; Function -Finite Element Formulation- Axisymmetric Elements- Coordinate System – Shape; Function -Finite Element Formulation. Elements used by any finite element analysis (FEA)

UNIT IV

Dynamic Analysis: Introduction – Basic Equations in Vibration –Types of Vibration- Mass matrices – Undamped free vibration -Finite Element Formulation (2node 1D element)

UNIT V

Selected Applications in Materials Science: Materials modeling and simulation across the length scale and applications: Modeling property prediction through first principle calculations. Monte Carlo Method for simulating nucleation and growth of grains in materials.

Suggested Books:

1. Erdogan Madenci and Ibrahim Guven, The Finite Element Method And Applications In Engineering Using ANSYSR, *The University of Arizona* 2006, Springer Science Business Media, LLC
2. Robert D.Cook, Finite Element Modeling for Stress Analysis, John Wiley & Sons, Inc. 1995.
3. Saeed Moaveni, "Finite Element Analysis Theory and Application with ANSYS", Prentice Hall, Upper Saddle River, New Jersey, 2008
4. Bathe K.-J. and Wilson E. L. Numerical Methods in Finite Element Analysis. – Prentice-Hall, Inc., 1976.
5. Dierk Raabe, Computational Materials Science-The Simulation of Materials Microstructures and Properties, WILEY-VCH Verlag GmbH. 1998.
6. Rao S. S. The Finite Element Method in Engineering. – Pergamon Press, 1989.

Course Outcomes: After completion this, student shall be able to

CO1: Gain an understanding of the theory behind computations and various tools relevant to the design of future materials

CO2: Use of Mathematical equation to predict the properties of materials

CO3: Use the software for better understanding of dynamical analysis of materials

CO4: Become aware of the various tools available for materials discovery and optimization.

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Dr. Pramod Kumar Yadav (Dr. Nishant Kaur)

Chandan Joshi (Dr. Chandan Joshi)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M	L						
CO2	L	H		M	L				L
CO3	M	H	L	M	M				M
CO4	L	H	M		H				M

H = Highly Related; M = Medium L = Low

COMPUTATIONAL MATERIALS SCIENCE LAB

CODE: BPH112A **Credit: 1**

A. SIMULATION

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and twoVariables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using software

B. ANALYSIS

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems

Course Outcomes: After completion this course, student shall be able to

CO1: Learn the software tools needed to analyze the dimensional problems of materials

CO2: have the exposure to different applications of simulation and analysis tools.

CO3: Make use of software for simulation and analysis for various applications

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M	H	M	L					M
CO2	H	M	L	M	M				
CO3	L	H	M		M				L

H = Highly Related; M = Medium L = Low

Prof Y. K. Vijay

(Dr. Nishant Saini)

Dr Pranav Soare

Chandan Joshi

(Dr. Chandan Joshi)

(Dr Abhishek Sharma)

RADIATION PROCESSES IN ASTROPHYSICS

CODE: BPH113A **Credits: 4+1**

UNIT I

Physics of Radiative Processes: From Maxwell to Planck to Einstein The classical wave equation; quantization of the field; statistics of phonons; thermal spectrum. Absorption, spontaneous emission, and stimulated emission: Einstein's A and B coefficients; detailed balance Phenomenological description of radiation, Thermodynamics of radiation Moments of the radiative intensity: radiative flux and pressure

UNIT II

Polarization in Astronomy: Stokes parameters . Equation of transfer . Optical depth . Large optical depth limit; scattering as a random walk. Radiative diffusion; local thermodynamic equilibrium

UNIT III

Radiation from Free particles: Maxwell's equations, Wave equation, retarded potentials, radiation field, Poynting vector, radiation from accelerated charge, bremsstrahlungLarmor formula Thomson/Compton scattering. Bremsstrahlung. Synchrotron

UNIT IV

Radiation Bound System: Radiation from Atoms and molecules. Equivalent width; curve of growth. Oscillator strengths; selection rules

UNIT V

Application of Radiative Processes: Ionization balance. HII regions Line formation in a wind; P Cygni profiles, Scattering by dust Mie theory Extinction coefficient Infrared emission, Interactions with plasma waves Dispersion Scintillation Faraday rotation.

Suggested Books:

1. Bethe, H. A., & Salpeter, E. E. 2008, Quantum Mechanics of One- and TwoElectron Atoms (Dover)
2. Chandrasekhar, S. 1960, Radiative Transfer (Dover)
3. Heitler, W. 1984, The Quantum Theory of Radiation (Dover)
4. Jackson, J. D. 1975, Classical Electrodynamics, 2nd edn. (Wiley)
5. Longair, M. S. 1992, High Energy Astrophysics, Vol. 1, Particles, Photons, and Their Detection, 2nd edn. (Cambridge University Press)
6. Mihalas, D. 1978, Stellar Atmospheres, 2nd edn. (W. H. Freeman)
7. Rybicki, G. B., & Lightman, A. P. 1979, Radiative Processes in Astrophysics (Wiley) Shu, F. H. 1991, 洧e Physics of Astrophysics, Vol. I, Radiation (University Science Books)

Course Outcome: After completion this course, student shall be able to

CO1: Acquire the knowledge and understanding of physical laws and principles focussed on Radiation mechanism.

CO2: Understand the polarizing phenomena of radiations.

CO3: Learn the process of radiation by free isolated charge to understand the radiation by astronomical objects.

CO4: Understand the mechanism of radiation from clusters of stars as bound system.

CO5: Understand the scattering and ionizing processes by radiations in space.

Prof. Y. K. Vijay

(Dr. Nishant Kumar)

Dr Kumar Saurabh

(Dr. Abhishek Sharma)

(Dr. Chandan Joshi)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		M	M				L	
CO2	H			L					M
CO3	H		L	M					L
CO4		M		L					
CO5	H	M		M					L

H = Highly Related; M = Medium L = Low

ELEMENTS OF ATOMIC AND MOLECULAR SPECTROSCOPY

CODE: BPH114A **Credits: 4**

UNIT-I

Determination of e/m of the Electron. Thermionic Emission. Isotopes and Isobars.

Introduction to Spectroscopy: X-rays: Ionizing Power, X-ray Diffraction, Bragg's Law. Bohr Atomic Model, Critical Potentials, X-rays-Spectra: Continuous and Characteristic X-rays, Moseley Law.

UNIT-II

Atoms in Electric and Magnetic Fields: Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Atoms in External Magnetic Fields: Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).

UNIT-III

Many electron atoms: Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

UNIT-IV

Molecular Spectra: Rotational Energy levels, Selection Rules and Pure Rotational Spectra of a Molecule. Vibrational Energy Levels, Selection Rules and Vibration Spectra. Rotation-Vibration Energy Levels, Selection Rules and Rotation-Vibration Spectra. Determination of Internuclear Distance.

Raman Effect: Quantum Theory of Raman Effect, Characteristics of Raman Lines, Stoke's and Anti-Stoke's Lines, Complimentary Character of Raman and infrared Spectra.

UNIT-V

Spectroscopy: Photoelectron spectroscopy – the photoelectric effect, UV photoelectron spectroscopy UPES, X-ray photoelectron spectroscopy XPES, electron binding energy, ESCA, Auger electron spectroscopy.

Suggested Books

1. Arthur Beiser: Concepts of Modern Physics, McGraw-Hill Book Company, 1987.
2. J. B. Rajam: (with foreword by Louis de Broglie) Atomic physics, S. Chand & Co., 2007.

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3. Ghatak and Thyagarajan: Optoelectronics, Oxford University Press.

Course Outcomes: After completion this course, student shall be able to-

CO1: Learn and understand the measurement of e/m, the fundamentals characteristics of spectrum by various diffraction processes.

CO2: Explain the behavior of atoms under the influence of electric and magnetic fields such as Stark effect, Zeeman Effect and Paschen Back effect respectively.

CO3: Describe the physics of spin orbit coupling, concept of total angular momentum and L-S and J-J coupling effect.

CO4: Explain and examine the rotational, vibrational spectra of diatomic molecules, and quantum theory of Raman Effect and its characteristics.

CO5: Demonstrate the physics of various experimental spectroscopy techniques.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAMOUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L		M					L
CO2	H	L	M	H	L				
CO3	H		M	H					
CO4	H	M	M	H	M				
CO5	M	H		M					L

H = Highly Related; M = Medium L = Low

ELEMENTS OF ATOMIC AND MOLECULAR SPECTROSCOPY - SEMINAR

CODE: BPH115A **Credit: 1**

Method of Evaluation:

During the seminar session each student is expected to prepare and present any topic as prescribed in syllabus, for duration of about 20 minutes. The students should address the techniques to study the spectroscopy critically with latest developments. Each student is expected to present at least twice during the semester and the internal assessment of the student will be evaluated based on that. At the end of the semester, for external assessment he / she has to submit a report on his / her topic and presentation, the marks are given based on the total performance.

Course Outcomes: After this course student shall be able to-

CO1: Use various teaching aids such as projectors, computers for simulations, power point presentation and demonstrative models.

CO2: Acquire the technical knowledge as well understand well about the behaviour of atoms and molecules.

CO3: Develop the skill of research attitude to review articles and able to prepare and present technical reports with appropriate conclusions/remarks.

Prof. Y.K. Vijay

Dr Pravar Tewari

(D. Nishant Tiwari)

Chandan Joshi

(Dr. Chandan Joshi)

(Dr. Abhishek Sharma)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		M		L	H				
CO2		L	M	H	M	M	L		L
CO3		M	L	H	M	H	M		L

H = Highly Related; M = Medium L = Low

MICROPROCESSOR AND MICROCONTROLLER

CODE: BPH116A **Credits: 4**

Unit I

Microprocessor Based Systems: Digital Computer, Microprocessor, Microcomputer, Microcontroller, Van Neumann and Harvard Architecture, CISC and RISC Processors

8085 & 8086 Microprocessor: Introduction to 8085 and 8086, Microprocessor architecture, Addressing modes, Instruction set and assembler directives, Assembly language programming, Modular Programming, Linking and Relocation, Stacks, Procedures, Macros, Interrupts and interrupt service routines, Byte and String Manipulation.

Unit II

8086 System Bus Structure: 8086 signals, Basic configurations, System bus timing, System design using 8086, I/O programming, Introduction to Multiprogramming, System Bus Structure, Multiprocessor configurations, Coprocessor, Closely coupled and loosely Coupled configurations, Introduction to advanced processors.

Unit III

I/O Interfacing: Memory Interfacing and I/O interfacing, Parallel communication interface, Serial communication interface, D/A and A/D Interface, Timer, Keyboard /display controller, Interrupt controller, DMA controller, Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

Unit IV

8051 Microcontroller: Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions.

Introduction to Arduino: Pin diagram and description of Arduino UNO. Basic programming

Unit V

8051 I/O port programming: Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description & their functions, I/O port programming in 805: Bit manipulation. Programming in C for arithmetic and logic operations, for ASCII and BCD conversions

Interfacing Microcontroller : Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Interfacing of LEDs, 7 Segment display device, LCD display, DIP Switches, Push Button switches, Key denounce techniques Keyboard Interfacing, ADC, DAC & Sensor Interfacing.

Suggested Books:

1. Mathur A.P., Introduction to Microprocessors., (3rd edn., Tata McGraw, New Delhi, 1995).

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Chandra Joshi

Dr Abhishek Sharma

2. Ram, Fundamentals of microprocessors and microcomputers-Dhanpat Rai Publications, New Delhi
3. Ramesh S. Gaonakar, Microprocessor Architecture, Programming and Application with the 8085-Penram International Publishing, Mumbai
4. The 8051 Microcontroller & Embedded Systems using Assembly and C By K. J. Ayala, D. V. Gadre (Cengage Learning , India Edition).
5. Programming and Customizing the 8051 Microcontroller by Myke Predko Tata Mcgraw Hill.

Course Outcomes: After completion this course, student shall be able to-

CO1: Understand the generic architecture, design and classifications, microprocessors and microcontrollers.

CO2: Learn the architecture, pin diagram, timing diagram, instruction set and programming in assembly language of microprocessor 8085 with a brief of Arduino.

CO3: Input/output operations and manipulation for arithmetic and logical operations with 8 bit microprocessor.

CO4: Learn the architecture, pin diagram, timing diagram, instruction set and programming in assembly language of microcontroller 8051.

CO5: Learn program assembly language programming of 8051 with and without interrupt service request and design microcontroller based small system

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	M					
CO2		H		L	M				L
CO3	L	M		M	L				M
CO4	L	M	L					L	
CO5		H	M	H					M

H=High; M=Medium; L=Low

MICROPROCESSOR AND MICROCONTROLLER LAB

CODE: BPH117A **Credit: 1**

Student has to perform the following simulations:

1. Write a program using 8085 and verify for addition of two 8-bit numbers
2. Write a program using 8085 and verify for addition of two 16-bit numbers (with carry)
3. Write a program using 8085 and verify for subtraction of two 8-bit numbers (display of borrow)
4. Write a program using 8085 and verify for subtraction of two 16-bit numbers (display of borrow)
5. Write a program using 8085 and test for multiplication of two 8-bit numbers by Bit Rotation method.
6. Write a program using 8085 and test for division of two 8-bit numbers by Repeated Subtraction method
7. Write a program using 8085 for finding square root of number and verify.

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8. Write a program using 8085 to arrange the number in ascending and descending order to check numbers 1's and 0's in a given number
9. Write a program using 8085 to find GCD of two numbers
10. Write a program using 8085 to find LCM of two numbers
11. Write a program using 8085 to add N two digit BCD numbers
12. Write a program to interface Keyboard with 8085.
13. Write a program to interface Temperature measurement module with 8085.
14. Interfacing of 8051 microcontroller with various display devices
15. Interfacing of 8051 microcontroller with Analog-to-Digital and Digital-to-Analog converter.
16. Interfacing of 8051 microcontroller with DC motor.
17. Write a program for Traffic light Control using 8051.
18. Write a program for Elevator control using 8051.

Suggested Books:

1. Embedded Systems: Architecture, Programming& Design, R.Kamal, 2008,Tata McGraw Hill
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G.Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
3. Embedded Microcomputor System: Real Time Interfacing, J.W.Valvano, 2000, Brooks/Cole
4. Embedded System, B.K. Rao, 2011, PHI Learning Pvt. Ltd

Course Outcomes: After completion this course, student shall be able to-

CO1: Acquire the knowledge of microprocessor based system performance.

CO2: Demonstrate the operation of microcontrollers and their role in I/O port programming.

CO3: Learn the arithmetic operations, ADC, DAC and microcontroller based system.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L							
CO2	L	H	M	L	H				
CO3	M		L		H				

H=High; M=Medium; L=Low

MATERIAL CHARACTERIZATION TECHNIQUES

CODE: BPH118A **Credits: 4**

UNIT I

X-Ray based characterization Principles and applications of X-ray diffraction, powder (polycrystalline) and single crystalline XRD techniques; DebyeScherrer equation to treat line broadening and strain induced in nanoparticles and ultra-thin films. Rotating anode and synchrotron based X-ray diffraction for probing structure. X-ray photoelectron spectroscopy – basic principle, Introductory idea of X-ray absorption techniques: XANES, EXAFS.

UNIT II

Prof. Y.K. Vijay

Dr. Kumar Sanu

Dr. Nishant Laws

Chanda Joshi

Dr. Nandan Joshi

Dr. Abhishek Sha

Electron Microscopy Techniques Introduction, Principles and applications of Electron beam, Electron beam interaction with matter. Scanning electron microscopy, transmission electron microscopy, Electron-diffraction. Scanning Probe Microscopy: Principles and applications, Atomic Force Microscope, Scanning Tunnelling Microscope.

UNIT III

Spectroscopic Techniques UV-VIS Spectrophotometers, IR/FTIR Spectrophotometers, Principles, operation and application for band gap measurements. Raman spectroscopy principles and applications. Optical microscope: Nanoparticle size measurement by Dynamic light scattering methods zeta potential.

UNIT IV

Magnetic Characterization Types of magnetic materials, Magnetic susceptibility, CurieWeis plot for paramagnetic materials, Neel temperature, Curie temperature VSM and SQUID magnetometers – M vs H, M vs T, MH-loops.

UNIT V

Electrical Measurements Cyclic Voltameter, Impedance Measurement, IV, AC and DC electric measurements, impedance spectral information.

Suggested Books:

1. Y. Leng, Materials Characterisation: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia), 2008.
2. S. Zhang, Lin Li, A. Kumar, Materials Characterisation Techniques, CRC press, 2008.
3. D.A. Skoog, F.J. Holler, S. R. Crouch, Instrumental Analysis, Cengage Learning, 2007.
4. J.C. Vickerman, I. Gilmore, Surface Analysis: The Principal Techniques, 2nd ed., John Wiley & Sons, Inc.2009.
5. W. W. Wendlandt, Thermal Methods of Analysis, John Wiley, 1974.
6. B. Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-Destructive Testing, 2nd ed., Narosa Publishing House, 2002.

Course Outcomes: At the end of the course, students will be able to:

CO1: Demonstrate the principle, construction and working of XRD techniques and identify the characterization techniques.

CO2: Acquire the knowledge of principle, construction and working of scanning and transmission electron microscopy

CO3: Identify the appropriate spectroscopy technique for required information

CO4: Understand the temperature dependence behavior of magnetic substances.

CO5: Understand the electrical properties of materials.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M	H	M	M					
CO2	H	L	M	L	L				
CO3	H	M	L	M	L				
CO4	M	L		L					
CO5	H	L	L	L					

H = Highly Related; M = Medium L = Low

MATERIAL CHARACTERIZATION LAB

CODE: BPH119A **Credit: 1**

Student has to perform the following experiments-

1. Production and measurement of X- Rays: (i) Study the effect of Voltage and current on spectra (ii) Study the effect of filters
2. Phase identification by XRD: Study about the about phase identification of different samples through XRD analysis
3. Indexing Powder Method: (i) To determine the lattice parameters of powder specimen, (ii) Determine precisely lattice parameters of these samples by using extrapolation curve fittings
4. Indexing of Diffraction Patterns (Ring Pattern & Spot Pattern)
5. Basics of Scanning Electron Microscopy: Secondary Electron and BSE imaging mode
6. Feature Size measurement: Porosity, Grain, and Reinforcement
7. Effect of Beam voltage on conducting and insulating samples
8. Basic operations of Transmission Electron Microscope (Imaging and Diffraction Pattern)
9. Electron Diffraction for various materials
10. Sample Preparation for TEM analysis (Bulk metal, Powder sample, Brittle material)
11. Cross-sectional Sample Preparation
12. To study the operating principle of Atomic Force Microscopy (AFM) and its usefulness.
13. Surface topography of materials (Metallic and ceramic) using AFM to estimate the level of roughness.
14. To study and obtain the high resolution images of CNT coated with Sn- based materials using AFM.
15. Magnetic Material characterization via Hysteresis

Suggested Books:

1. Characterization of Nanostructure materials by XZ.L.Wang, Instrumental Methods of Analysis, 7th edition- Willard, Merritt, Dean, Settle
2. Scanning Probe Microscopy: Analytical Methods (NanoScience and Technology)-Roland Wiesendanger
3. X-Ray Diffraction Procedures: For Polycrystalline and Amorphous Materials, 2nd Edition Harold P. Klug, Leroy E. Alexander
4. Transmission Electron Microscopy: A Textbook for Materials Science (4-Vol Set)- David B. Williams and C. Barry Carter
5. Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM - Ray F. Egerton.

Course Outcomes: After this course student shall be able-

CO1: Understand the physics behind the various metallographic techniques.

CO2: Describe the principle, construction and working of XRD techniques and analysis the X-ray diffraction data

CO3: Describe the principle, construction and working of various electron microscopies.

Prof. V.K. Vijay

(Dr. Nishant Tyagi)

Dr. Pramod Kumar Chaudhary

(Dr. Chandan Joshi)

Dr. Abhishek Sharma

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L		L	M				
CO2	L	H	M	M	H		L		M
CO3	L	H	L	M	H	H			L

H = Highly Related; M = Medium L = Low

PLANETARY AND ATMOSPHERIC SCIENCE

CODE: BPH120A **Credits: 4**

UNIT-I

Overview of Solar system: Dynamics: Two-body problem, Three-Body Problem (Lagrangian points) - Resonances - Tidal forces - Solar energy balance and transport: Radiative Equilibrium

UNIT-II

Planetary Atmospheres: Structure, Composition, Atmospheric Escape - Planetary surfaces: Surface morphology - Impact cratering; Minor Bodies: Meteories, Asteroids, Comets, Minor planets, Trans-Neptunian Objects, Centaurs - Planetary rings

UNIT-III

Planet Formation: Evolution of protoplanetary disks, Growth of solid bodies, Formation of Terrestrial and Giant planets, Extrasolar Planets: Detection techniques, Estimating planetary masses, sizes, orbital parameters Habitable zones: factors influencing habitable zone, continuously habitable zone, Missions to study Planets and Overview of Extrasolar planet

UNIT-IV

Atmosphere: The Neutral atmosphere, atmospheric nomenclature, geopotential height, expansion and contraction, fundamental forces in the atmosphere, apparent forces, atmospheric composition, solar radiation interaction with the neutral atmosphere, climate change, atmospheric aerosols.

UNIT-V

Atmospheric Waves and Detection: Surface water waves, wave dispersion, acoustic waves,buoyancy waves, propagation of atmospheric gravity waves (AGWs) in a nonhomogeneous medium, Qualitative idea of Lamb waves, Rossby waves; Various type of atmospheric radars, Application of radars to study atmospheric phenomena, Lidar and its applications, Application of Lidar to study atmospheric phenomenon.

Suggested Books:

1. Planetary Sciences by Imke de Pater and Jack J. Lissauer, 2015
2. Exoplanetary Atmospheres: Theoretical Concepts and Foundations by Kevin Heng, 2017
3. Introduction to Astrochemistry: Chemical Evolution from Interstellar Clouds to Star and Planet Formation by Satoshi Yamamoto, 2017
4. Fundamental Planetary Science: Jack Lissauer & Imke de Pater (Latest Edition) - Cambridge University Press
5. Physics of the Upper Atmosphere edited by J, A. Ratcliffe, Cavendish Laboratory, University of Cambridge. Academic Press New York and London (1960).
6. Source book on the Space Sciences - Samuel Glasstone, Princeton, New Jersey.
7. Introduction to Ionospheric Physics – Henry Rishbeth and Owen K. Garriot.
8. Climatology, An atmospheric Science – John E. Oliver and John J. Hindore.

Prof. Y.C. Vijay (Dr. Nishant Gaur) (Dr. Abhishek Sharma)

Course Outcomes: After completion this course, student shall be able to-
CO1: Understand the basics of dynamics of Solar system
CO2: Acquire the knowledge about the structure of planetary atmosphere.
CO3: familiar with the process of planet formation, various zones and detection method for them.
CO4: Understand the atmospheric composition, fundamental forces and knowledge of aerosols.
CO5: Acquire the knowledge of various atmospheric waves and their detection techniques.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	M					L
CO2		L	M	H	L				M
CO3	H	M		L	L				
CO4	H			H					M
CO5	M	H	L	M					L

H = Highly Related; M = Medium L = Low

PLANETARY AND ATMOSPHERIC SCIENCE - SEMINAR

CODE: BPH121A **Credit: 1**

Method of Evaluation:
During the seminar session each student is expected to prepare a critical report on the recent exploration and developments about space and planet for duration of about 20 minutes. Each student is expected to present at least twice during the semester and the student will be evaluated on the basis of contents and methodology of exploration. At the end of the semester, he / she will have to submit a conclusive report on his / her topic with seminar presentation and marks will be given based on cumulative assessment. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal

Course Outcome: After completion this course, student shall be able to
CO1: Review, prepare and present technical reports on space science.
CO2: Learn to maintain the sanctity of referring the information like texts, related research-based outcomes by others globally.
CO3: Develop the management skill to accomplish the project/task and produce his/her own critics and thoughts as results to be work upon.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1			H	H	L		M		L
CO2		H	M	M	H	L			M
CO3				L		M	H		

H = Highly Related; M = Medium L = Low

Prof. Y.K. Vijay
Dr. Nishant Gaur
Dr. Abhishek Ghosh

RENEWABLE ENERGY

CODE: BPH122A **Credits: 4**

UNIT I

Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity

UNIT II

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

UNIT III

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass

UNIT IV

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

UNIT V

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric Energy harvesting applications, Human power. Environmental issues and Renewable sources of energy, sustainability.

Suggested Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

Course Outcomes: After completion this course, student shall be able to-

CO1: Learn about the energy resources available natural or developed various alternates.

CO2: Understand the developments and importance of solar energy and its applications.

CO3: Acquire the knowledge of other natural renewable sources of energy off-shore wind energy, tidal energy

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Dr. Nishant Saini

Chandan Joshi

(Dr. Chandan Joshi)

Dr. Abhishek Sharma

Dr. Pramod Sharma

CO4: Learn about energy generated from geothermal and hydropower resources and technologies.

CO5: Learn about piezoelectric energy and able to review critically about sustainability of renewable energy resources and environmental issues.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L	M	M				H	H
CO2	H	M	H	M	M			H	M
CO3	H	M	M	M	L			H	M
CO4	H	M	M	L			L	M	
CO5	M	L	H	M	M			H	M

H = Highly Related; M = Medium L = Low

RENEWABLE ENERGY - SEMINAR

CODE: BPH123A **Credit: 1**

Method of Evaluation:

During the seminar session each student is expected to prepare and present any topic on alternate energy resources as prescribed in syllabus, for duration of about 20 minutes. The students should address the issues critically with latest developments. Each student is expected to present at least twice during the semester and the internal assessment of the student will be evaluated based on that. At the end of the semester, for external assessment, he / she has to submit a report on his / her topic and has to present a seminar, the marks are given based on the total performance.

Course Outcomes: After this course student shall be able to-

CO1: Use various teaching aids such as projectors, computers for simulations, power point presentation and demonstrative models.

CO2: Enhance his knowledge and develop his analyzing power to resolve the environmental and sustainability issues.

CO3: Develop the skill of research aptitude to review articles and able to prepare and present technical reports with appropriate conclusions/remarks.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		M		L	H				
CO2		L	M	H	M	M	L		L
CO3		M	L	H	M	H	M		L

H = Highly Related; M = Medium L = Low

Prof. Y.K. Vijay

(Dr. Nishant Saini)

(Dr. Chandan Joshi)

ANTENNA THEORY & PROPAGATION

CODE: BPH124A **Credits: 1**

Unit I

Review of Maxwell's Equation: Radiation of e.m waves and introducing Antenna; Vector Potential and Retarded Vector Potential; Radiation fields of a Hertzian dipole (electric); Duality Principle, Radiation fields due to short magnetic dipole.

Unit II

Antenna Characteristics: Radiation Pattern, Beam Width; Radiation Resistance and efficiency; Directivity and Gain; Impedance, VSWR, Polarization; Effective height and Receive Aperture; Noise Temperature of Antenna. Radiation fields and Characteristics of $\lambda/2$ dipole; discussion on $\lambda/4$ monopole antenna; Current distribution and Radiation patterns of center-fed dipoles of length λ, $3\lambda/2$ and 2λ. Horizontal and Vertical antennas over a plane ground.

Unit III

Antenna Arrays: Electric Field due to 2 element arrays, 3 element Arrays; Pattern Multiplication; Uniform Linear Array: End fire and Broad side; Phased array.

Characteristics and properties: Travelling Wave Antenna, Helical Antenna, Folded Dipole, Yagi-Uda Array, Loop Antenna, Electrically Short Antennas, Broad Band Antenna (Log periodic Antenna), Microstrip Patch Antenna, Smart Antennas

Radiation from an aperture: Sectoral and Pyramidal Horn Antennas, Design of Optimum Horn Antenna; Parabolic and Corner Reflectors and feed systems.

Unit IV

Methods of Propagation: Ground Wave Propagation, Components of ground wave, Field strength dependence on physical factors. Sky wave Propagation; Ionospheric Layers; Virtual Height, Critical Frequency, MUF, Skip distance, Sporadic Reflections. Space wave propagation: Tropospheric Scatter, Ducting Super refraction, Sub refraction.

Unit V

Physical (Medium) effects on Radio wave Propagation: Absorption, Refraction and Radio Horizon, Diffraction, Multipath Propagation and fading, Noise, Doppler effect, Friss Transmission Formula, SNR of a Radio Link.

Suggested Books:

1. Antenna (for all application), John D. Kraus and Ronald J. Marhefka; Tata- MacGraw Hill, 3rd Edition.
2. Antenna & Wave Propagation, K.D Prasad; Satya Prakashan, New Delhi, 3rd Edition.
3. Antenna Theory: Analysis & Design, Constantine A. Balanis; Willey, 3rd Edition.
4. Elements of Electromagnetics; Mathew N.O. Sadiku, Oxford University Press, 5th Edition.
5. Electromagnetic Waves & Radiating Systems, EC Jordan & K.G. Balmain; Pearson Education, 2nd Edition.
6. Microstrip Antenna Design Handbook- Ramesh Garg; Artech House.

Course Outcomes: After completion this course, student shall be able to-

CO1: Understand the fundamentals of radiations and due to dipoles.
CO2: Define the various antenna parameters and analyze the various radiation patterns.
CO3: Classify and learn the array and patch antenna with their characteristics.
CO4: Aware of method of wave propagation in various medium.
CO5: Learn the effect of medium and characteristics of wave propagation.

Dr Pranav Arora

Prof Y.K. Vijay

(Dr. Nishant Gaur)

(Dr. Abhishek Jha)

(Dr. Anandan Joshi)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	M					
CO2		H	M	L	L			L	M
CO3	H	M						L	L
CO4	M		L		M			L	
CO5	M	L		M	L				L

H=High; M=Medium; L=Low

ANTENNA THEORY & PROPAGATION LAB

CODE: BPH125A **Credit: 1**

Student has to perform the following computational modelling and simulations:

1. To study different type of antennas.
2. To plot radiation pattern of monopole, dipole, folded dipole antenna and calculate its parameters.
3. To plot radiation pattern of Helix antenna and calculate its parameters.
4. To plot radiation pattern of Loop (Circular, Rectangular) antenna and calculate its parameters.
5. To plot radiation pattern of Yagi uda antenna and calculate its parameters.
6. To plot radiation pattern of Log Periodic antenna and calculate its parameters.
7. To plot 2-Dimensional and 3-Dimensional radiation pattern of the directional antenna using simulation software.
8. To plot radiation pattern of end fire and broad side array and calculate its parameters.
9. To plot radiation pattern of aperture antenna and calculate its parameters.
10. To plot radiation pattern of planner (inset feed and 2X1) and calculate its parameters.
11. To design Microstrip patch antenna using simulation software.

Suggested Books:

1. Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont,The Services Text Book of Radio, vol. 5, Standard Publishers Distributors, Delhi.
2. Electronic and Radio Engineering – F.E. Terman, McGraw-Hill, 4thEdition, 1955.
3. Antennas for All Applications – John D. Kraus and Ronald J.Marhefka, 3rd Edition, TMH, 2003.

Course Outcomes: After completion this course, student shall be able to-

CO1: Understand the behaviour of various antennas.

CO2: Analyze the pattern of radiations generated by different antennas.

CO3: Develop the skill of using simulating software and program to design the patch antenna.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX

CO1	L	H		L					L
CO2	H	M	H	M	M		L		M
CO3	M	L	H	M	H			L	M

H=High; M=Medium; L=Low

FUNDAMENTALS OF POLYMER SCIENCE

CODE: BPH126A **Credits: 4**

Unit-I

Basic concepts - Molecular forces - chemical bonding - Molecular weight studies - molecular weight distribution-configuration-conformation-Tacticity-Transitions in polymers-viscoelasticity-types of macromolecules-classification of polymers.

Unit-II

Structure and Mechanical properties: Crystalline nature of polymers, factors affecting crystallization, crystallization and melting, melting: factors affecting. The glassy state and glass transition. Tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness.

Unit-III

Mechanism of Polymers: General characteristics of chain growth polymerisation, initiators, generation of initiators, free radical, anionic and cationic polymerization, ring opening polymerization, General characteristics of step growth polymerization, mechanism of step growth polymerization, coordination polymerization.

Polymerization techniques: Homogeneous polymerization techniques- Bulk, Solution, Heterogeneous polymerization techniques- Emulsion, Suspension, solid phase polymerisation.

Unit-IV

Polymer solutions: Thermodynamics of polymer solutions, Solution properties of polymers, Solubility parameter, Conformation of polymer chains in polymer solutions, Flory-Huggins theory, Flory-Krigbaum theory, Solution viscosity, Osmotic pressure, Molecular size and molecular weight.

Polymer Degradation : Types of degradation: Thermal, mechanical, ultrasonic and photodegradation, oxidative and hydrolytic degradation, Biodegradable polymers.

Unit-V

Industrial Polymers: Production, properties and applications of industrial polymers; PP, PE,PVC, PS, polyamide, polyacrylates, polyester (PET, PBT). General purpose rubbers: NR, SBR, NPR, EPDM etc.

Electrically and Photoactive Polymers: Conjugated polymers, intrinsically conductive polymers, Polymers with piezoelectric, pyrroelectric and ferroelectric properties, Polymers in insulators, telecommunications and FET. Photo conducting polymers, polymers used in optical applications, photo resists and semiconductor fabrication, Light emission in polymers, Semi conducting materials as light emitting materials.

Suggested Books:

1. F. W. Billmeyer, Textbook of polymer science, 3rd ed., John Wiley & Sons, Asia, New Delhi, 1994.
2. G. Odian, Principles of Polymerization, 4th ed., Wiley-Interscience, 2004
3. R. J Young and P. A. Lovell, Introduction to Polymers, 2nd ed., 2004

Prof Y.K. Vijay

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Dr. Abhishek

Dr. Bhanudayal Joshi

4. P. Gosh, Polymer Science and Technology, Mc-Graw Hill, 2002.
5. Robert William Dyson, Speciality Polymers, 2nded., Blackie Academic &Professional, 1998
6. Manas Chanda, Salil K. Roy, Industrial Polymers, Specialty Polymers, and their Applications, CRC Press, 2008
7. Johannes Karl Fink, Hand book of Engineering and Specialty Polymers, John Wiley & Sons, Vol.2, 2011.

Course Outcomes: After completion this course, student shall be

CO1: Able to understand the importance of the polymers as an important class of materials
CO2: Able to acquire the basic knowledge, structure-property relationship and mechanical properties of polymers.
CO3: Able to learn the mechanism and techniques for synthesis of polymers with specified properties.
CO4: Able to understand the basics of polymers solutions and possible ways of degradation.
CO5: Aware of the potential of polymers in electric, electronic, optical and structural applications.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L		L					
CO2	H	M	L	M					L
CO3	M	H		M	L				
CO4	M	L	M	M				H	
CO5	H	M	L	M	L			M	L

H = Highly Related; M = Medium L = Low

FUNDAMENTALS OF PLOYMER SCIENCE - SEMINAR

CODE: BPH127A **Credit: 1**

Method of Evaluation:

During the semester, seminar session of each student is expected to prepare and present a topic on advance materials or latest ongoing research on smart materials, for duration of about 15 minutes. Each student is expected to present at least twice during the semester and the student is evaluated based on that on account of internal assessment. At the end of the semester, he / she has to produce a comprehensive report on his / her topic of seminar and assessment will be done.

Course Outcomes: After this course student shall be able-

CO1: To use various learning aids such as computer, e-resources, tools for presentation and demonstrative models.
CO2: To develop the critical analyzing skill to review, prepare and present scientific review articles or a publishable article.
CO3: To develop a professional approach and ability to work in team or individual to compile the project/seminar with meaningful outcomes.

Prof Y.K. Vijay
Dr. Nishant Kaur
Chandan Joshi
Dr. Abhishek Jha

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		H		M	M				
CO2	H	M	H	L			L		M
CO3			L			H			L

H = Highly Related; M = Medium L = Low

ASTRONOMICAL TECHNIQUES

CODE: BPH128A **Credits: 4**

UNIT-I

Telescope: Types of telescopes, telescope mounting systems, optical telescopes, Infrared, Ultraviolet, X-ray and Gamma-ray telescopes. Schmidt telescopes. Solar telescopes. Idea of designing and construction of a simple optical telescope. Sky charts and their importance.

UNIT-II

Detectors: Classification of detectors, characteristics of detectors. Detectors for optical and infrared wavelength regions, working principle of Charge Coupled Device (CCD). Application of CCD for stellar imaging, photometry and spectroscopy.

UNIT-III

Photometry: Astronomical photometry- simple design of an astronomical photometer, Observing technique with a photometer, Correction for atmospheric extinction.

Spectroscopy: Astronomical spectroscopy- Spectral classification. Simple design of astronomical spectrograph. Radial velocity measurements.

UNIT-IV

Radio Astronomical Techniques: Electromagnetic spectrum, Radio window, Antenna parameters. Various types of antennas, Qualitative-Non-steerable, partially steerable and fully steerable radio telescopes. construction of a simple radio telescope. Receiver systems and their calibration. Overview - Radio Interferometer, MST Radar for Ionospheric studies.

UNIT-V

Optical Techniques: Ray optical theory of image formation-Paraxial approximation and Doppler shifts; Diffraction theory of image formation- Airy pattern, two point resolution, Rayleigh criterion, Marechal criterion.

Stellar Interferometry: Michelson Stellar Interferometer, Fizeau-Stephen Interferometer

Suggested Books

7. C.R.Kitchin: Astrophysical Techniques (4th edition).
8. Ian S. McLean: Electronic Imaging in Astronomy: Detectors and instrumentation (2nd edition).
9. Steve B. Howell: Handbook of CCD Astronomy (2nd edition).
10. A. E. Roy and D. Clarke: Astronomy Principles and Practice (Part-3, 4th edition).
11. W. A. Hiltner (Ed): Astronomical Techniques.
12. Gordon Walker: Astronomical Observations - an Optical Perspective (Cambridge Univ Press).

Course Outcomes: After completing this course, student shall be able to

CO1: Acquire the detailed knowledge of telescopes and their functionality.

CO2: Acquire the basic understanding about the working of detectors for various radiations in space.
CO3: Understand the importance of photometric and spectroscopic techniques to understand the Universe.
CO4: Learn about the various radio waves astronomical techniques.
CO5: Acquire the knowledge of various image formation techniques and optical interferometric instruments.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		H	L	M					L
CO2	M	H	L	M					L
CO3	M	H		M					
CO4		M		M	L				M
CO5	M	H	L	M	L				M

H = Highly Related; M = Medium L = Low

ASTRONOMICAL TECHNIQUES - SEMINAR

CODE: BPH129A **Credit: 1**

Method of Evaluation:
During the seminar session each student is expected to prepare a report on the recent exploration and developments in astronomical techniques for duration of about 20 minutes. Each student is expected to present at least twice during the semester and the student will be evaluated on the basis of contents and methodology of exploration. At the end of the semester, he / she will have to submit a conclusive report on his / her topic with seminar presentation and marks will be given based on cumulative assessment. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal

Course Outcome: After completion this course, student shall be able to
CO1: Review, prepare and present technical reports on space science.
CO2: Learn to maintain the sanctity of referring the information like texts, related research-based outcomes by others globally.
CO3: Develop the management skill to accomplish the project/task and produce his/her own critics and thoughts as results to be work upon.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1			H	H	L		M		L
CO2		H	M	M	H	L			M
CO3				L		M	H		

H = Highly Related; M = Medium L = Low

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(Dr. Nishant Saini)

(Dr. Abhishek Sharma)

OPEN ELECTIVE COURSES

(OFFERED FOR OTHER UNDERGRADUATE PROGRAMS OTHER THAN PHYSICS)

MECHANICS

CODE: DPH005A

Credits: 3

UNIT-I

Kinematics – Position, velocity and acceleration (ID and 3D)

Work and Energy Theorem: Work and Kinetic Energy Theorem. Conservative and Non-Conservative Forces. Potential Energy. Energy Diagram. Stable and Unstable Equilibrium. Gravitational Potential Energy. Elastic Potential Energy. Force as Gradient of Potential Energy. Work and Potential energy. Work done by Non-conservative Forces. Law of Conservation of Energy.

UNIT-II

Collisions: Elastic and Inelastic Collisions between particles. Treatment in Centre of Mass and Laboratory Frames.

UNIT-III

Rotational Dynamics: Angular Momentum of a Particle and System of Particles. Torque. Conservation of Angular Momentum. Rotation about a Fixed Axis. Moment of Inertia. Calculation of Moment of Inertia for Rectangular

UNIT-IV

Gravitational Motion: Law of gravitation. Inertial and Gravitational Mass. Momentum of variable-mass system: Motion of rocket. Motion of a projectile in Uniform gravitational field, Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse

UNIT-V

Motion under Central Force: Potential and Field due to Spherical Shell and Solid Sphere. Motion of a Particle under Central Force Field. Two Body Problem and its Reduction to One Body Problem and its Solution. The Energy Equation and Energy Diagram.

Suggested Books

1. University Physics; F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
2. An introduction to Mechanics; Daniel Kleppner, Robert J. Kolenkow, McGraw-Hill, 1973.
3. Theoretical Mechanics; M.R. Spiegel, 2006, Tata McGraw Hill
4. Mechanics Charles Kittel, Walter Knight, Malvin Ruderman, Carl Helmholz, Burton Moyer, Berkeley physics course.
5. Mechanics; D. S. Mathur, S. Chand & Company Limited, 2000.

Course Outcomes: After completing this course, students shall be able to-

CO1: Understand laws of motion and their application, various laws of conservation

CO2: Learn the collisions between particles in center of mass and laboratory frames.

CO3: Understand of moment of inertia about the given axis for different uniform mass distributions, the basics of kinematics and dynamics linear and rotational motion.

CO4: Learn the physics to understand motion under gravity and solve the equations of Newtonian gravity

CO5: Demonstrate the motion under the influence of central force and applications.

Prof. Y.K. Vijay

(Dr. Nishant Varma)

Dr. Abhishek Kumar

Dr. Raman Sen

Chandan Joshi

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		L	H					M
CO2	L	M		H					
CO3	M		H				M		L
CO4	L	H	H	M				L	M
CO5	M		M	H				L	

H=High; M=Medium; L=Low

OPTICS

CODE: DPH006A

Credits: 3

UNIT-I

Geometrical Optics : Fermat's Principle: Fermat's Principle of Least Time and Extremum Path. Laws of Reflection and Refraction, Laws of Refraction at Spherical Surface, Thin lens Formula.

Wave Optics: Nature of Light- Theories of Light. Electromagnetic Nature of Light, Definition of a Wave Front. Propagation of a Wave Front. Huygens Principle of Secondary Wavelets.

UNIT-II

Interference: Interference: Division of Amplitude and Division of Wavefront. Young's Double Slit Experiment. Lloyd's Mirror and Fresnel's Biprism. Phase Change on Reflection: Stoke's treatment. Interference in Thin Films: Parallel and Wedge-shaped Films. Fringes of Equal Inclination (Haidinger Fringes) and Fringes of Equal Thickness (Fizeau Fringes). Newton's Rings: Measurement of Wavelength and Refractive Index.

UNIT-III

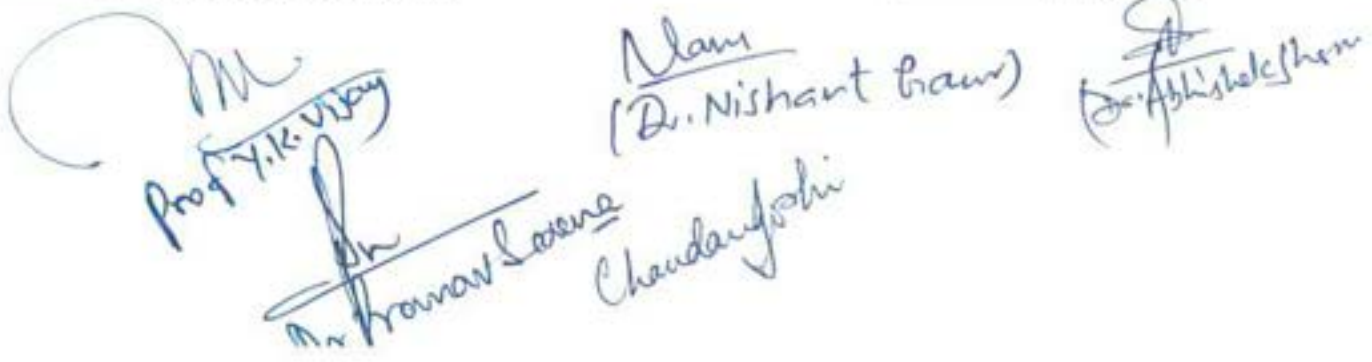
Fresnel's Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula (Qualitative Discussion), Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Comparison of a Zone plate with a Convex lens.

UNIT-IV

Fraunhoffer Diffraction: Diffraction due to a Single Slit, and a Plane Transmission Grating. Rayleigh's criterion of resolution. Resolving Power and Dispersive Power of a Plane Diffraction Grating.

UNIT-V

Polarization: Electromagnetic nature of light, Polarized light, Plane of vibrations and plane of polarizations, linearly polarized light by (i) reflection (Brewster's law), (ii) refraction, (iii) scattering, (iv) selective absorption; Polarizer and Analyzer - Malus law, E Ray and O Ray, positive and negative crystals; production of circularly and elliptically polarized light, Quarter and Half Wave Plates. Specific rotation.



Suggested Books

1. Fundamentals of Optics; F. A. Jenkins and Harvey Elliott White, McGraw-Hill, 1976.
2. Priciples of Optics; B. K. Mathur, 1995, Gopal Printing
3. A Text Book of Optics; N Subrahmanyam, Brij Lal and Avadhanulu, S. Chand.
4. Fundamentals of Optics; H.R. Gulati and D.R. Khanna, R. Chand Publications, 1991.
5. Optics; Eugene Hecht and A R Ganesan, Pearson Education, 2002.
6. Contemporary Optics; A. K. Ghatak & K. Thyagarajan, Plenum Press, 1978.

Course Outcomes: After the completion of course, student shall be able to

CO1: Understand geometrical approximation, Fermat's and Huygen's principles, and the paraxial matrix formalism for refractive and reflective surfaces, including Guass thin lens formula.
CO2: Learn the basic understanding of Interference with different interferometric devices and analytical understanding of fringes formation in various applications.
CO3: Understand and Analyze the bending of light phenomena due to various zones.
CO4: Classify the diffraction phenomena due to single slit and plane transmission grating using Rayleigh Criteria.
CO5: Learn the production of polarized light, role of optical crystals and retardation plates, analysis of specific rotation of light.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		M						
CO2	H	M	H	M				L	M
CO3		H	M	L				L	
CO4	M	L	H	M					M
CO5	H			L				M	M

H=High; M=Medium; L=Low

ELECTRICITY AND MAGNETISM

CODE: DPH007A

Credits: 3

UNIT-I

Electric Field: Electric Field: Electric Field and Lines. Electric Field **E** due to a Ring of Charge. Electric Flux. Gauss's law. Gauss's law in Differential form. Applications of Gauss's Law: **E** due to point charge, an Infinite Line of Charge.

UNIT-II

Electric Potential: Line Integral of Electric Field. Conservative Nature of Electrostatic Field. Relation between **E** and V. Electrostatic Potential Energy of a System of Charges. Electric

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(Dr. Nishant Gaur)
(Dr. Abhishek Sharma)
Chandan Joshi

Potential due to Dipole, a Charged Wire, a Charged Disc. Calculation of Electric Field from Potential, Force and Torque on a Dipole.

UNIT-III

Dielectric Properties of Matter: Dielectrics: Electric Field in Matter. Capacitor with a Dielectric. Polarization, Polarization Charges and Polarization Vector, Electric Susceptibility. Gauss's law in Dielectrics. Displacement vector **D**. Relations between the three Electric Vectors.

UNIT-IV

Magnetic Field: Magnetic Effect of Currents: Magnetic Field **B**. Magnetic Force between Current Elements and Definition of **B.** Magnetic Flux. Biot-Savart's Law: **B** due to (1) a Straight Current Carrying Conductor and (2) Current Loop, Ampere's Circuital law (Integral and Differential Forms), Properties of **B.**

UNIT-V

Electromagnetic induction: Faraday's law (Differential and Integral forms). Lenz's Law. Self and Mutual Induction. Energy stored in a Magnetic Field.

Maxwell's Equations: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves.

Reference Books

1. Edward M. Purcell: Electricity and Magnetism, McGraw-Hill Education, 1986.
2. Arthur F. Kip: Fundamentals of Electricity and Magnetism, McGraw-Hill, 1968.
3. D C Tayal; Electricity and Magnetism, Himalaya Publishing House, 1988
4. J. H. Fewkes & John Yarwood: Electricity & Magnetism, Oxford Univ. Press, 1991.
5. David J. Griffiths: Introduction to Electrodynamics, Benjamin Cummings, 1998 (Also, PHI).

Course Outcomes: After completion this course, student shall be able to-

CO1: Demonstrate the fundamentals of electrostatics and formalism of electric field due to various geometrical charge conductors.

CO2: Articulate the knowledge of dipole, conductors and capacitors / condenser in terms of electric potential.

CO3: Describe the properties and behavior of dielectric materials with understanding of Gauss' law.

CO4: Describe the production of magnetic field due to current carrying elements and magnetic dipole.

CO5: Explain Faraday-Lenz to articulate the relationship between electric and magnetic fields and behavior of Maxwell laws in different mediums.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1		H	M			L			
CO2	H			L				L	H

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Chandan Joshi

CO3	M	H	M		L	M			
CO4	H	H	M	M	L		L		M
CO5			H			I			H

H = Highly Related; M = Medium L = Low

CIRCUIT ANALYSIS AND BASIC ELECTRONICS

CODE: DPH008A

Credits: 3

Unit I

Electrical circuit elements: voltage and current sources, R, C, L, M, I, V, linear, non linear, active and passive elements, inductor current and capacitor voltage continuity, Kirchhoff's laws, Elements in series and parallel, superposition in linear circuits, controlled sources, energy and power in elements, energy in mutual inductor and constraint on mutual inductance.

Unit II

Network analysis: Nodal analysis with independent and dependent sources, modified nodal analysis, mesh analysis, notion of network graphs, definition of nodes, trees, twigs, links, co-tree, independent sets of branch currents and voltages.

Unit III

Network theorems: Voltage Shift Theorem, Zero Current Theorem, Tellegen's Theorem, Reciprocity, Substitution Theorem, Thevenin's and Norton's theorems, compensation theorem, maximum power transfer.

Unit IV

Semiconductors: Intrinsic and extrinsic semiconductors, Energy Level Diagram. Conductivity and Mobility, carrier statistics, and thermal equilibrium carrier concentration.

Unit V

Theory of PN junctions: p and n Type Semiconductors.. pn Junction Fabrication (Simple Idea). Barrier Formation in pn Junction Diode. Current Flow Mechanism in Forward and Reverse Biased Diode, Definition of Potential Barrier, V-I characteristics.

Suggested Books

1. Basic and Applied Electronics-T.K Bandyopadhyay, Books and Allied Pvt Ltd (2002)
2. V.K.Mehta, "Principles of Electronics", S.Chand & Co
3. B.L.Theraja, "Basic solid state Electronics", S.Chand &Co
4. R. L. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, Pearson Education (2006).
5. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
6. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning.
7. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill

Prof T.K. Vijay

(Dr. Nishant Gaur)

Dr. Kanav Saini

Chanda Joshi

Dr. Abhishek Sharma

Course Outcomes: After completion this course, student shall be able to

CO1: Apply Kirchhoff's rules to analyze the circuits consisting of parallel and/or series combinations of voltage sources and resistors and understand their graphical relationship.
CO2: Acquire the knowledge of important terminology like nodes, trees, twigs, links, co-tree, independent sets of branches in a complex circuit.
CO3: Demonstrate and learn various network theorems and their applications in electrical circuit and electronics.
CO4: Learn and understand the basics of semiconductors and the role of diffused charged carriers in changing the properties.
CO5: Demonstrate the current flow mechanism, nature of potential barrier and understand the characteristics of diode.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	M		L	L				L
CO2	M	H	M						
CO3	L		H	M	L		L		M
CO4	H	M		L					
CO5	M		H	M			L		

H = Highly Related; M = Medium L = Low

ELEMENTS OF MODERN PHYSICS

CODE: DPH009A

Credits: 3

UNIT -I

Failures of Classical Theory and Development of Quantum Mechanics; Planck's Hypothesis, Blackbody Radiation: Quantum radiation formulation; Photo-electric effect and Compton scattering.

UNIT-II

De-Broglie wavelength and matter waves; Davisson-Germer experiment. Heisenberg uncertainty principle – applications, Wave packets, Probability, Wave amplitude and wave functions.

UNIT - III

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization, one dimensional infinitely rigid box- energy eigen values and eigen functions, normalization.

UNIT-IV

Lasers: Induced Absorption, Spontaneous and Stimulated emissions, Relationship between Einstein's Coefficients, Principle of Lasing. Metastable State, Optical Pumping and Population Inversion. Components of Laser, Types of Lasers-Three-Level and Four-Level, Qualitatively-He-Ne Laser and Diode laser.

Prof Y.K. Vijay Dr Pramod Kumar (Dr. Nishant Gaur) Chandan Joshi

UNIT-V

Holography: Principle of Holography. Qualitative idea of Recording and Reconstruction Method. Difference between Holography and photography, Applications of Holography

Suggested Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

Course Outcomes: After completion this course, student shall be able to

CO1: Understand the development of quantum mechanics and ability to discuss and interpret experiments that reveal the quantum nature of light.
CO2: Understand the dual nature of light, and development of wave packets and wave function.
CO3: Understand the central concepts of quantum mechanics in the formulation of Schrodinger wave equation and application.
CO4: Learn the fundamentals of lasing mechanism and types.
CO5: Understand the basics and technique of Holography.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAMOUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H		M	H	M	L			M
CO2	H		L						
CO3	H	L		L	M				
CO4	H	M	H	M					M
CO5	H	H	H	M	M	H	L	M	H

H = Highly Related; M = Medium L = Low

SOLID STATE PHYSICS

CODE: DPH010A

UNIT-I **Credits:3**

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Types of Bonds. Ionic Bond. Covalent Bond. Van der Waals Bond. Diffraction of x-rays by Crystals. Bragg's Law.

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(Dr. Nishant Tiwari)

Chandan Joshi

UNIT-II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monatomic and Diatomic Chains, Qualitative Description of the Phonon Spectrum in Solids. Einstein and Debye Theories of Specific Heat of Solids. T^3 Law.

UNIT-III

Dielectric Properties of Materials: Dielectric Polarization. Dielectric Constant. Electric Susceptibility, Polarizability.

UNIT-IV

Elementary Band Theory of Solids: Effective Mass of Electron, Concept of Holes, Band Gaps. Energy Band Diagram and Classification of Solids. Law of Mass Action. Insulators and Semiconductors (P type and N type). Conductivity in Semiconductors, mobility.

UNIT-V

Superconductivity: Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Idea of BCS theory (No derivation).

Suggested Books

1. Charles Kittel: Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc.
2. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, Rita John, 2014, McGraw Hill
5. A. J. Dekkar: Solid State Physics, Macmillan India Limited, 2000.
6. J. S. Blackmore: Solid State Physics, Cambridge University Press, Cambridge.
7. N. W. Ascroft and N. D. Mermin: Solid State Physics, (Harcourt Asia, Singapore 2003).

Course outcomes:- After completion this course, students shall be able to-

CO1: Understand about crystalline and amorphous substances, about lattice structure, concept of Brillouin zones and diffraction of X-rays by crystalline materials.

CO2: Understand the knowledge of lattice vibrations, phonons and in depth of knowledge of Einstein and Debye theory of specific heat of solids.

CO3: Acquire the essence of dielectric properties of materials.

CO4: Demonstrate the formation of bands in solids, and their classification into insulators, conductors and semiconductors.

CO5: Understand the basics of superconductors. Type I and II superconductors, their properties.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	H	L		M	L				
CO2	M								
CO3	M	L	M	H					M
CO4	H		M	M	L				M
CO5	L	M		M					L

H = Highly Related; M = Medium L = Low

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Dr. Nishant Gaur

Dr. Abhishek Sharma

Dr. Ramanand Choudhary

NUCLEAR AND PARTICLE PHYSICS

CODE: DPH011A

UNIT-I **Credits: 3**

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot.

UNIT-II

Radioactivity decay: Basics of (a) Alpha decay: basics of α-decay processes, (b) β-decay: energy kinematics for β-decay, (c) Gamma decay: Gamma rays emission & kinematics

UNIT-III

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate.

UNIT-IV

Detector and Accelerators: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors.

UNIT-V

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws, Qualitative Idea of baryon number, Lepton number, Isospin, Strangeness and charm.

Suggested Books:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
5. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
6. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
7. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOPInstitute of Physics Publishing, 2004).
8. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
9. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
10. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)

Course Outcomes: After completion this course, student shall be able to-

CO1: To describe and explain the properties of nuclei.

CO2: Learn the various nuclear disintegration processes and understand the theory.

CO3: Develop basic understanding of the interaction of various nuclear radiations with matter in low and high energy.

CO4: Understand, construct and operate simple detector systems for nuclear radiations and training to work with various types of nuclear accelerators.

CO5: Demonstrate basic knowledge of elementary particles as fundamental constituent of matter, their properties, and conservation laws.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes	Program Outcomes (POs)								
	I	II	III	IV	V	VI	VII	VIII	IX
CO1	M		L	H					L
CO2	L								
CO3	H	L	L	M					M
CO4	M	H	M						
CO5	H		M	M					M

H = Highly Related; M = Medium L = Low

Dr. Pranav Saini

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(Dr. Chandan Joshi)